Appendix I - Sample Preparation and Analytical Methods

A1.1 Bass Metals Samples

Bass Metals drill core samples were analysed by Amdel Mineral Laboratories in South Australia. Most samples are halved or quartered drill core samples that range between 15 and 30 cm in length. The following is a summary the sample preparation and analytical procedures used by Amdel to produce the results used in this thesis.

Samples were dried to a core temperature of approximately 100°C. The samples were then jaw crushed individually and milled in a LM5 pulveriser to 90% passing 106 µm. An analytical pulp of 250 g was taken from the bulk and the residue retained, where practical, in the original bag. The samples were digested using a mixture of acids including hydrofluoric (HF) acid. The addition of HF allows an almost complete break-up of quartz matrices allowing dissolution of most minerals. The samples were then analysed using a combined ICM-OES and ICP-MS assay method.

Mixed Acid Digest, ICP-OES finish:

IC3E — A subsample of up to 0.2 g of the analytical pulp is digested using an HF/multi acid digest and the solution is presented to an ICPOES for the quantification of the elements of interest. Range is to 1% except Fe (30%), Ca (5%), Mg (2%), P (2%), Mn (2%), K (1%). The detection limit of each element is given in brackets next to the element of interest.

Ag (1 ppm)	**Al (10 ppm)	As (3 ppm)	**Ba (10 ppm)
**Be (2 ppm)	Bi (5 ppm)	Ca (10 ppm)	Cd (2 ppm)
Ce (10 ppm)	Co (2 ppm)	**Cr (2 ppm)	Cu (2 ppm)
Fe (100 ppm)	**K (10 ppm)	Li (2 ppm)	Mg (10 ppm)
Mn (5 ppm)	Mo (3 ppm)	**Na (10 ppm)	**Nb (5 ppm)
Ni (2 ppm)	P (10 ppm)	Pb (5 ppm)	**S (50 ppm)
Sb (5 ppm)	**Sc (2 ppm)	Sr (2 ppm)	**Ti (10 ppm)
V (2 ppm)	Y (2 ppm)	Zn (2 ppm)	

Some elements may not be readily digestible by the IC3E scheme listed above. The commonly noted have been marked with **.

Mixed acid digest, ICP-MS finish:

IC3M	A subsample of 0.2 g of the analytical pulp is digested using an HF/multi acid digest and the solution is presented to an ICPMS for the quantification of the elements of interest. Range is to 0.1%. Some elements may be inappropriate due to mineralisation present. The detection limit of each element is given in brackets next to the element of interest.			
	Ag (0.1 ppm)	As (0.5 ppm)	**Be (0.5 ppm)	Bi (0.1 ppm)
	Cd (0.1 ppm)	Cs (0.1 ppm)	Ce (0.5 ppm)	Co (0.2 ppm)
	Cs (0.1 ppm)	Cu (0.5 ppm)	Ga (0.1 ppm)	Hf (1 ppm)
	In (0.5 ppm)	**La (0.5 ppm)	Mo (0.1 ppm)	**Nb (0.5 ppm)
	Ni (2 ppm)	Pb (0.5 ppm)	Rb (0.1 ppm)	Sb (0.5 ppm)
	**Sc (2 ppm)	**Se (0.5 ppm)	Sr (0.1 ppm)	**Sn (0.1 ppm)
	**Ta (0.5 ppm)	**Te (0.2 ppm)	Th (0.1 ppm)	Tl (0.1 ppm)
	U (0.1 ppm)	Y (0.1 ppm)	**W (0.5 ppm)	Zn (0.5 ppm)
Some elements may not be readily digestible by the IC3M scheme listed above. The commonly noted have been marked with **				

Chromium-free equipment was used by Amdel for sample preparation; however, the metal that is labelled “Cr free” still contains around 300 ppm. In extreme cases of contamination from the bowls, there could be 6 ppm carryover to sample, based on a low weight soft material milled for long periods of time (S. Richardson, pers. comm., July 2010). Two sets of barren quartz material were submitted by Bass Metals geologists along with the samples. One set of 16 samples reported low Cr values of 2-12 ppm, averaging at 6 ppm. The second set of 9 samples reported Cr values of 28-40 ppm, averaging at 35 ppm. The four-acid digest ICP-MS/OES method does not provide SiO_2 analyses but a sum of major oxides for first set of barren quartz material averages 10.5%, suggesting a SiO_2 content near 89.5%. The second set of barren quartz material clearly has carbonate minerals in addition to quartz with CaO, MgO and Fe_2O_3 contents averaging 17.1%, 2.4% and 3.2%, respectively. Assuming these major elements occur as carbonates, the approximated SiO_2 content would average around 48.6%.

Quality control and quality assurance (QAQC) procedures taken by Amdel for the Bass Metals samples are summarised below:

Sample pulverisers are cleaned mechanically and/or with vacuum. Quartz or blue metal washes are utilised to ensure no carry over contamination between individual jobs. Samples of wash materials are retained by the lab for analysis if required. A nominal one in twenty (5%) of all samples are analysed in duplicate. This indicates any variance at the analytical stage. In addition, re-splits are also analysed (if required) to determine the precision of the sample preparation and analytical procedures. Blanks and reference materials are randomly inserted into every rack of samples. These provide a measure of accuracy.

The reference materials used may be national, international reference standards or in-house. Specific materials were selected based on the elements of interest and expected ranges of concentration. Values are determined independently through various means including laboratory round robin. These materials are prepared in bulk and are used extensively across a number of Amdel's laboratories. Samples returning anomalous results would be re-assayed by techniques considered appropriate for the level of analyte encountered.

Additional QAQC measures were carried out by Bass Metals geologists by inserting blank samples (barren quartz±carbonate), duplicates, and certified ore grade base metal reference materials.

A1.2 Research Samples – This Study

Drill core samples for this study were also analysed by Amdel Mineral Laboratories in South Australia. Samples were collected during re-logging of Fossey, Fossey East and Mount Charter drill core. There are all quartered drill core samples with 2-5 cm wide slabs saved for future reference. While most samples are 11-24 cm long, there are some that are 30-39 cm long for monomict and polymict breccias. One duplicate sample and one standard were submitted for every 17 samples (total of 19).

Similar to the Bass Metals samples, the research samples for this study were dried to a core temperature of approximately 100°C. The samples were then jaw crushed individually and milled in a LM5 pulveriser to 90% passing 106 µm. For this study, two small subsamples were taken; one is fused with lithium borate followed by dissolution in nitric acid, and the other is dissolved in a mixture of nitric, perchloric and hydrofluoric acids. The two subsamples are analysed by both ICPMS and ICPOES to achieve the lowest detection limits for each element. The procedures are summarised below.

Fusion, Acid Digest, ICPOES Finish:

IC4/LB101	An aliquot of sample is accurately weighed and fused with lithium metaborate at high temperature in a Pt crucible. The fused glass is then digested in nitric acid. This process provides complete dissolution of most minerals including silicates. Volatile elements are lost at the high fusion temperatures. In some cases, elements are reported as oxides. Nature of the sample may compromise detection limits. The solution is presented to an ICPOES for the determination of elements of interest. LOI determined gravimetrically. The detection limit of each element is given in brackets next to the element of interest. Al_2O_3 (0.01%) · CaO (0.01%) · K_2O (0.01%) · Total Fe as Fe_2O_3 (0.01%) MgO (0.01%) · MnO (0.01%) · Na_2O (0.01%) · P_2O_5 (0.01%) SiO_2 (0.01%) · TiO_2 (0.01%) · Cr (20 ppm) · Sc (5 ppm) V (20 ppm) · L.O.I. (0.01%)

Fusion, Acid Digest, ICPMS Finish:

IC4M/LB102	An aliquot of the IC4/LB101 fusion solution listed above is presented to an ICPMS for the determination of elements of interest. The detection limit of each element is given in brackets next to the element of interest. Ba (10 ppm) · Be (0.5 ppm) · Bi (3 ppm) · Ce (1 ppm) Co (15 ppm) · Cs (3 ppm) · Ga (1 ppm) · Hf (1 ppm) In (0.5 ppm) · La (1 ppm) · Mo (2 ppm) · Nb (10 ppm) Rb (0.5 ppm) · Sb (1 ppm) · Sn (10 ppm) · Sr (5 ppm) Ta (2 ppm) · Te (5 ppm) · Th (0.5 ppm) · U (0.5 ppm) W (3 ppm) · Y (1 ppm) · Zr (15 ppm)
IC4R/LB102	An aliquot of the IC4/LB101 fusion solution listed above is presented to an ICPMS for the determination of elements of interest. The detection limit of each element is give in brackets next to the element of interest. Dy (0.5 ppm) · Er (1 ppm) · Eu (0.5 ppm) · Gd (1 ppm) Ho (0.5 ppm) · Lu (0.5 ppm) · Nd (0.5 ppm) · Pr (1 ppm) Sm (0.5 ppm) · Tb (0.5ppm) · Tm (1 ppm) · Yb (1 ppm)

Mixed Acid Digest, ICP-OES finish:

IC3E/MA101	An aliquot of sample is accurately weighed and digested with a mixture of nitric, perchloric and hydrofluoric acids. The digestion temperature and time is carefully controlled to near dryness, followed by a final dissolution in hydrochloric acid. This digest approximates a 'total' digest in most samples. Some refractory minerals may not be fully attacked. High concentrations of some elements may require special treatment. The nature of the samples may compromise detection limits. The detection limit of each element is given in brackets next to the element of interest. Ag (1 ppm) · As (3 ppm) · Cu (2 ppm) · Ni (2 ppm) Pb (5 ppm) · Zn (2 ppm)

Mixed acid digest, ICP-MS finish:

IC3M/MA102	An aliquot of the IC3E/MA101 solution listed above is presented to an ICPMS for the determination of elements of interest. The detection limit of the element is given in brackets next to the element. Tl (0.1 ppm)

The detection limits quoted by Amdel are set for the standard sample types analysed for the corresponding method. Results are reported by Amdel in increments equivalent to the limit of detection, or a set number of significant figures, whichever is the largest. Accuracy equivalent to ±2 times detection limit is achievable up to a concentration of 10 times the detection limit, and then ±5% of the value thereafter.

Additional quality control samples were included in each batch of sample submission. Batch number 1AD4348 contains 38 samples, including one standard (GBM306-12) and two duplicates. GBM306-12 is a certified ore grade base metal reference material distributed by Geostats Pty. Ltd. and only the concentrations of Cu, Ni, Zn and Pb are certified control values. Published concentrations of other elements are single results of neutron activation analyse and are intended for the use of matrix identification. The results of the Amdel analysis for the GBM306-12 standard are within 15% of the published results, except for some elements that are at concentrations close to detection limits (Table A1.1).

Duplicate samples are quartered core samples. The original half core sample is halved lengthwise using a diamond bladed core saw. Inherent mineralogical variations within the actual core sample would lead to chemical variations from the duplicate samples.

The reported values for the duplicate samples are mostly within 10% of the average between the two sets of duplicate samples, respectively (Table A1.2). Calcium concentrations are more variable between sample HL673-12 and its duplicate. Carbonate vein distribution amongst the two samples could be a potential cause, but there is no corresponding variation in the reported LOI values. Sample HLD961-25 and its duplicate also show large variations in Fe and As content; an uneven distribution of pyrite mineralisation in those samples is a likely cause. Other elements such as Sc, Be, Co, Gd, Ho and Tb also show variations in concentrations greater than 10% but they occur at levels close to detection limit.

The second batch of samples (batch number 2AD4550) contains 38 samples, including two previously analysed samples (both by XRF at the University of Tasmania and four-acid digestion ICPMS at Amdel for Bass Metals) and two duplicates. The XRF analyses were carried out at the University of Tasmania by Philip Robinson (Analyst) using a PAN analytical Axios Advanced XRF. Major elements were analysed as oxides from discs fused at 1100°C in 5% Au/95% Pt crucibles, with a lithium-metaborate flux. Trace elements were determined from pressed powder pills. No corrections were applied to the results based on the standards analysed with the samples.

The results of both reference samples used in batch 2AD4550 are compared to the XRF (UTAS and the four-acid digestion ICPMS (Bass Metals) in Tables A1.3 and A1.4. In general, the differences within two sets of analyses (batch 2AD4550 compared to UTAS and batch 2AD4550 compared to Bass Metals) are mostly within 10% from the averaged value. Those that exceed the 10% range in difference tend to be of elements that occur at concentrations close to detection limits.

The results from batch 2AD4550 also show better correlations with those from the XRF analyses compared to the ICPMS analyses. The most likely cause for this is the digestion method used for the samples analysed for this study. These samples have been prepared by fusion with lithium metaborate at high temperature, followed by digestion in nitric acid to achieve total dissolution. On the other hand, the Bass Metals samples were prepared by a mixed acid digestion only, so incomplete digestion may occur in some instances. The XRF method and the combined fusion and mixed acid digest ICPMS method do not have incomplete digestion issues and this may be the reason that the results from these analyses are more similar.

The reported values for the duplicate samples in this batch are also mostly within 10% of the average between the two sets of duplicate samples, respectively (Table A1.5). Calcium, Ga, La, Y, Zr, As and Pb concentrations are more variable in the two sets of duplicate samples. The duplicate sample of HLD1018-18 has higher CaO concentrations that are accompanied by elevated LOI and Sr values, suggesting that the duplicate sample may indeed have a larger amount of calcite or carbonate. There is no obvious reason for higher variations (11.8-16.4%) observed in the reported Ga, La, Y and Zr concentrations. Differences in As and Pb content are likely associated with irregular sulfide distribution amongst the quartered core samples. Other elements that occur at low concentrations such as Na, Cs, Dy and Tb also show more variations in their concentrations amongst the duplicated samples, but they occur at levels close to detection limit.

Table A1.1 – Analytical results of reference sample GBM306-12 for batch 1AD4348.

Element	Method	Detection Limit	Amdel Results	Published Results	Difference (%)
SiO_2 (%)	IC4	0.01	57.7	n/a	
TiO_2 (%)	IC4	0.005	0.255	n/a	
Al_2O_3 (%)	IC4	0.01	8.72	n/a	
Fe_2O_3 (%)	IC4	0.01	5.63	5.28	6.72%
MnO (%)	IC4	0.01	2.49	n/a	
MgO (%)	IC4	0.01	0.61	n/a	
K_2O (%)	IC4	0.01	3.89	n/a	
CaO (%)	IC4	0.01	1.17	n/a	
Na_2O (%)	IC4	0.01	1.91	1.86	2.68%
P_2O_5 (%)	IC4	0.01	0.09	n/a	
LOI (%)	IC4	0.01	9	n/a	
Cr (ppm)	IC4	20	5600	4960	12.9%
Sc (ppm)	IC4	5	<5	4.1	
V (ppm)	IC4	20	25	n/a	
Ba (ppm)	IC4M	10	40	<50	
Be (ppm)	IC4M	0.5	1	n/a	
Bi (ppm)	IC4M	3	4	n/a	
Ce (ppm)	IC4M	1	5	4	25.0%
Co (ppm)	IC4M	15	25	27	7.41%
Cs (ppm)	IC4M	3	24	23	4.35%
Ga (ppm)	IC4M	1	12	n/a	
Hf (ppm)	IC4M	1	6	n/a	
In (ppm)	IC4M	0.5	<0.5	n/a	
La (ppm)	IC4M	1	2	2.4	16.7%
Mo (ppm)	IC4M	2	<2	2	
Nb (ppm)	IC4M	10	<10	n/a	
Rb (ppm)	IC4M	0.5	705	710	0.70%
Sb (ppm)	IC4M	1	4	5.6	28.6%
Sn (ppm)	IC4M	10	<10	<100	
Sr (ppm)	IC4M	5	35	n/a	
Ta (ppm)	IC4M	2	<2	1.1	
Te (ppm)	IC4M	5	<5	n/a	
Th (ppm)	IC3M	0.1	6	n/a	
Tl (ppm)	IC4M	0.5	<0.5	0.7	
U (ppm)	IC4M	0.5	0.5	0.6	16.7%
W (ppm)	IC4M	3	<3	1	
Y (ppm)	IC4M	1	5	n/a	
Zr (ppm)	IC4M	15	260	n/a	
Dy (ppm)	IC4R	0.5	1	n/a	
Er (ppm)	IC4R	1	<1	n/a	
Eu (ppm)	IC4R	0.5	<0.5	<0.2	
Gd (ppm)	IC4R	1	<1	n/a	
Ho (ppm)	IC4R	0.5	<0.5	n/a	
Lu (ppm)	IC4R	0.5	<0.5	0.09	
Nd (ppm)	IC4R	0.5	3	n/a	
Pr (ppm)	IC4R	1	<1	n/a	
Sm (ppm)	IC4R	0.5	0.5	0.8	37.5%
Tb (ppm)	IC4R	0.5	<0.5	<0.5	
Tm (ppm)	IC4R	1	<1	n/a	
Yb (ppm)	IC4R	1	<1	0.6	
Ag (ppm)	IC3E	1	7	5	40.0%
As (ppm)	IC3E	3	<3	5.5	
Cu (ppm)	IC3E	2	14600	14804*	1.38%
Ni (ppm)	IC3E	2	9335	9483*	1.56%
Pb (ppm)	IC3E	5	26900	26812*	0.33%
Zn (ppm)	IC3E	2	21000	20500*	2.44%

**Certified control values by Geostats Pty. Ltd. Difference (%) is calculated as the absolute value of the difference between the Amdel and the published values, divided by the published value and reported as a percentage.*

Table A1.2 - Analytical results of duplicate samples for batch 1AD4348.

Element	Method	Detection Limit	HL673-12	HL673-16 (Duplicate of HL673-12)	Standard Deviation (%)	HLD961-25	HLD961-27 (Duplicate of HLD961-25)	Standard Deviation (%)
SiO_2 (%)	IC4	0.01	58.2	57.9	0.26%	51.1	45	6.35%
TiO_2 (%)	IC4	0.005	0.625	0.61	1.21%	0.555	0.475	7.77%
Al_2O_3 (%)	IC4	0.01	17.6	17.3	0.86%	16.5	14.9	5.10%
Fe_2O_3 (%)	IC4	0.01	6.44	6.3	1.10%	6.34	8.4	14.0%
MnO (%)	IC4	0.01	0.16	0.17	3.03%	0.27	0.32	8.47%
MgO (%)	IC4	0.01	4.03	3.87	2.03%	4.19	3.32	11.6%
K_2O (%)	IC4	0.01	4.76	4.67	0.95%	4.27	4.04	2.77%
CaO (%)	IC4	0.01	1.16	2.04	27.5%	6.38	8.95	16.8%
Na_2O (%)	IC4	0.01	0.07	0.06	7.69%	0.09	0.08	5.88%
P_2O_5 (%)	IC4	0.01	0.08	0.07	6.67%	0.1	0.14	16.7%
LOI (%)	IC4	0.01	5.53	5.5	0.27%	7.39	8.5	6.99%
Cr (ppm)	IC4	20	90	80	5.88%	115	105	4.55%
Sc (ppm)	IC4	5	30	25	9.09%	25	20	11.1%
V (ppm)	IC4	20	215	205	2.38%	195	170	6.85%
Ba (ppm)	IC4M	10	2630	2855	4.10%	1280	1055	9.64%
Be (ppm)	IC4M	0.5	3	3.5	7.69%	2.5	1	42.9%
Bi (ppm)	IC4M	3	<3	<3		<3	<3	
Ce (ppm)	IC4M	1	55	60	4.35%	60	50	9.09%
Co (ppm)	IC4M	15	25	20	11.1%	20	20	0%
Cs (ppm)	IC4M	3	6	6	0%	8	8	0%
Ga (ppm)	IC4M	1	16	16	0%	14	13	3.70%
Hf (ppm)	IC4M	1	3	3	0%	2	2	0%
In (ppm)	IC4M	0.5	<0.5	<0.5		<0.5	<0.5	
La (ppm)	IC4M	1	29	30	1.69%	31	27	6.90%
Mo (ppm)	IC4M	2	<2	<2		<2	2	
Nb (ppm)	IC4M	10	<10	<10		<10	<10	
Rb (ppm)	IC4M	0.5	175	165	2.94%	175	155	6.06%
Sb (ppm)	IC4M	1	16	17	3.03%	8	9	5.88%
Sn (ppm)	IC4M	10	<10	<10		<10	<10	
Sr (ppm)	IC4M	5	30	35	7.69%	65	75	7.14%
Ta (ppm)	IC4M	2	<2	<2		<2	<2	
Te (ppm)	IC4M	5	<5	<5		<5	<5	
Th (ppm)	IC3M	0.1	8.5	8	3.03%	3.7	3.5	2.78%
Tl (ppm)	IC4M	0.5	8.5	8.5	0%	9	7.5	9.09%
U (ppm)	IC4M	0.5	3	3	0%	2.5	2.5	0%
W (ppm)	IC4M	3	4	4	0%	<3	<3	
Y (ppm)	IC4M	1	25	25	0%	23	22	2.22%
Zr (ppm)	IC4M	15	110	100	4.76%	105	90	7.69%
Dy (ppm)	IC4R	0.5	4.5	5	5.26%	4	4	0%
Er (ppm)	IC4R	1	3	3	0%	2	2	0%
Eu (ppm)	IC4R	0.5	2.5	3	9.09%	1.5	1.5	0%
Gd (ppm)	IC4R	1	4	5	11.1%	4	4	0%
Ho (ppm)	IC4R	0.5	1	1	0%	1	0.5	33.3%
Lu (ppm)	IC4R	0.5	<0.5	<0.5		<0.5	<0.5	
Nd (ppm)	IC4R	0.5	27	28	1.82%	23.5	21.5	4.44%
Pr (ppm)	IC4R	1	7	7	0%	7	6	7.69%
Sm (ppm)	IC4R	0.5	5	5.5	4.76%	4.5	4	5.88%
Tb (ppm)	IC4R	0.5	0.5	1	33.3%	0.5	0.5	0%
Tm (ppm)	IC4R	1	<1	<1		<1	<1	
Yb (ppm)	IC4R	1	3	3	0%	2	2	0%
Ag (ppm)	IC3E	1	<1	<1		<1	<1	
As (ppm)	IC3E	3	55	50	4.76%	95	140	19.1%
Cu (ppm)	IC3E	2	85	95	5.56%	60	70	7.69%
Ni (ppm)	IC3E	2	26	26	0%	24	27	5.88%
Pb (ppm)	IC3E	5	15	15	0%	65	70	3.70%
Zn (ppm)	IC3E	2	230	225	1.10%	100	115	6.98%

The standard deviation (%) is calculated as the standard deviation of the two samples, divided by the average of the samples and reported as a percentage.

Table A1.3 – Comparison of analytical results for reference sample 360692 in batch 2AD4550.

Element	Method	Detection Limit	360692 (Batch 2AD4550)	360692 (UTAS)	Standard Deviation (%)	360692 (Bass Metals)	Standard Deviation (%)
SiO_2 (%)	IC4	0.01	60.6	59.98	0.51%	67.2	5.16%
TiO_2 (%)	IC4	0.005	0.305	0.29	2.69%	0.28	3.64%
Al_2O_3 (%)	IC4	0.01	13.1	13.25	0.57%	12.2	3.70%
Fe_2O_3 (%)	IC4	0.01	9.2	8.91	1.60%	7.96	7.22%
MnO (%)	IC4	0.01	0.29	0.29	0.68%	0.25	8.34%
MgO (%)	IC4	0.01	5.29	5.58	2.67%	5.04	2.42%
K_2O (%)	IC4	0.01	1.17	1.10	3.08%	1.05	5.48%
CaO (%)	IC4	0.01	2.12	2.07	1.19%	1.86	6.51%
Na_2O (%)	IC4	0.01	2.92	2.89	0.52%	2.93	0.09%
P_2O_5 (%)	IC4	0.01	0.09	0.09	1.12%	0.08	3.67%
LOI (%)	IC4	0.01	5.39	5.29	0.94%		
Cr (ppm)	IC4	20	270	331	10.2%	190	17.4%
Sc (ppm)	IC4	5	20	23	5.88%	17	8.11%
V (ppm)	IC4	20	115	127	4.80%	100	6.98%
Ba (ppm)	IC4M	10	855	898	2.46%	850	0.29%
Be (ppm)	IC4M	0.5	0.5			1	33.3%
Bi (ppm)	IC4M	3	<3	<2		<0.1	
Ce (ppm)	IC4M	1	120	118	0.67%	120	0%
Co (ppm)	IC4M	15	25	25	0.60%	25.5	0.99%
Cs (ppm)	IC4M	3	<3			0.9	
Ga (ppm)	IC4M	1	13			14	3.70%
Hf (ppm)	IC4M	1	3			2	20.0%
In (ppm)	IC4M	0.5	<0.5			<0.5	
La (ppm)	IC4M	1	65	67	1.81%	70	3.70%
Mo (ppm)	IC4M	2	<2	1.3		0.5	
Nb (ppm)	IC4M	10	<10	6.3		5.5	
Rb (ppm)	IC4M	0.5	27	26	1.31%	25	3.85%
Sb (ppm)	IC4M	1	<1			0.5	
Sn (ppm)	IC4M	10	<10			<0.1	
Sr (ppm)	IC4M	5	130	133	1.31%	125	1.96%
Ta (ppm)	IC4M	2	<2			<0.5	
Te (ppm)	IC4M	5	<5			<0.2	
Th (ppm)	IC3M	0.1	15	15	1.15%	17	6.25%
Tl (ppm)	IC4M	0.5	0.2			0.2	0%
U (ppm)	IC4M	0.5	4	5	5.88%		
W (ppm)	IC4M	3	<3			1	
Y (ppm)	IC4M	1	17	16	2.41%	16.5	1.49%
Zr (ppm)	IC4M	15	95	101	3.18%	80	8.57%
Dy (ppm)	IC4R	0.5	3.5				
Er (ppm)	IC4R	1	2				
Eu (ppm)	IC4R	0.5	2				
Gd (ppm)	IC4R	1	5				
Ho (ppm)	IC4R	0.5	0.5				
Lu (ppm)	IC4R	0.5	<0.5				
Nd (ppm)	IC4R	0.5	44.5	44	0.79%		
Pr (ppm)	IC4R	1	13				
Sm (ppm)	IC4R	0.5	6.5				
Tb (ppm)	IC4R	0.5	0.5				
Tm (ppm)	IC4R	1	<1				
Yb (ppm)	IC4R	1	2				
Ag (ppm)	IC3E	1	<1			<0.1	
As (ppm)	IC3E	3	<3			<3	
Cu (ppm)	IC3E	2	20	16	9.89%	16	11.1%
Ni (ppm)	IC3E	2	85	94	4.76%	80	3.03%
Pb (ppm)	IC3E	5	35	5	75.4%	<5	
Zn (ppm)	IC3E	2	160	126	11.7%	125	12.3%

The standard deviation (%) is calculated as the standard deviation of the two samples, divided by the average of the samples and reported as a percentage. The results of batch 2AD4550 are compared with the values reported from UTAS (by XRF and ICPMS) and then with the values reported from Bass Metals (4 acid digest, ICPMS).

Table A1.4 – Comparison of analytical results for reference sample 364977 in batch 2AD4550.

Element	Method	Detection Limit	364977 (Batch 2AD4550)	364977 (UTAS)	Standard Deviation (%)	364977 (Bass Metals)	Standard Deviation (%)
SiO_2 (%)	IC4	0.01	48.7	48.22	0.50%	54.16	5.31%
TiO_2 (%)	IC4	0.005	0.835	0.83	0.36%	0.85	0.93%
Al_2O_3 (%)	IC4	0.01	21.9	22.27	0.84%	20.84	2.49%
Fe_2O_3 (%)	IC4	0.01	10.5	10.22	1.35%	9.63	4.31%
MnO (%)	IC4	0.01	0.07	0.07	2.78%	0.06	7.13%
MgO (%)	IC4	0.01	2.8	2.87	1.23%	2.72	1.47%
K_2O (%)	IC4	0.01	3.22	3.33	1.68%	3.40	2.69%
CaO (%)	IC4	0.01	1.87	1.93	1.58%	1.86	0.25%
Na_2O (%)	IC4	0.01	3.81	3.97	2.06%	3.92	1.46%
P_2O_5 (%)	IC4	0.01	0.52	0.63	9.64%	0.53	0.66%
LOI (%)	IC4	0.01	5.06	5.2	1.36%		
Cr (ppm)	IC4	20	<20	8		4	
Sc (ppm)	IC4	5	35	37	3.18%	27	12.9%
V (ppm)	IC4	20	320	352	4.78%	285	5.79%
Ba (ppm)	IC4M	10	750	853	6.42%	750	0%
Be (ppm)	IC4M	0.5	2			1.5	14.3%
Bi (ppm)	IC4M	3	<3	<2		<0.1	
Ce (ppm)	IC4M	1	170	191	5.76%	170	0%
Co (ppm)	IC4M	15	25	27	4.03%	28	5.66%
Cs (ppm)	IC4M	3	4			2.8	17.6%
Ga (ppm)	IC4M	1	20			29	18.4%
Hf (ppm)	IC4M	1	4			5	11.1%
In (ppm)	IC4M	0.5	<0.5			<0.5	
La (ppm)	IC4M	1	90	95	2.49%	85	2.86%
Mo (ppm)	IC4M	2	<2			0.4	
Nb (ppm)	IC4M	10	15	12.0	11.1%	10.5	17.6%
Rb (ppm)	IC4M	0.5	95	112	8.39%	90	2.70%
Sb (ppm)	IC4M	1	2			3.5	27.3%
Sn (ppm)	IC4M	10	<10			2.5	
Sr (ppm)	IC4M	5	105	131	11.2%	120	6.67%
Ta (ppm)	IC4M	2	<2			0.5	
Te (ppm)	IC4M	5	<5			0.2	
Th (ppm)	IC3M	0.1	24.5	27	3.92%	25.5	2.00%
Tl (ppm)	IC4M	0.5	1.1			0.9	10.0%
U (ppm)	IC4M	0.5	6.5	7	3.70%		
W (ppm)	IC4M	3	4			3.5	6.67%
Y (ppm)	IC4M	1	20	26	13.6%	24.5	10.1%
Zr (ppm)	IC4M	15	170	209	10.4%	215	11.7%
Dy (ppm)	IC4R	0.5	6				
Er (ppm)	IC4R	1	3				
Eu (ppm)	IC4R	0.5	3				
Gd (ppm)	IC4R	1	9				
Ho (ppm)	IC4R	0.5	1				
Lu (ppm)	IC4R	0.5	<0.5				
Nd (ppm)	IC4R	0.5	95	83	6.56%		
Pr (ppm)	IC4R	1	20				
Sm (ppm)	IC4R	0.5	15				
Tb (ppm)	IC4R	0.5	1				
Tm (ppm)	IC4R	1	<1				
Yb (ppm)	IC4R	1	2				
Ag (ppm)	IC3E	1	<1			<0.1	
As (ppm)	IC3E	3	4			10	42.9%
Cu (ppm)	IC3E	2	12	12	2.13%	10	9.09%
Ni (ppm)	IC3E	2	46	47	0.65%	43	3.37%
Pb (ppm)	IC3E	5	25	6	59.7%	5	66.7%
Zn (ppm)	IC3E	2	200	190	2.64%	180	5.26%

The standard deviation (%) is calculated as the standard deviation of the two samples, divided by the average of the samples and reported as a percentage. The results of batch 2AD4550 are compared with the values reported from UTAS (by XRF and ICPMS) and then with the values reported from Bass Metals (4 acid digest, ICPMS).

Table A1.5 - Analytical results of duplicate samples for batch 2AD4550.

Element	Method	Detection Limit	HLD1017-18	HLD1017-28 (Duplicate of HLD1017-18)	Standard Deviation (%)	FUD17-10	FUD17-20 (Duplicate of FUD17-10)	Standard Deviation (%)
SiO_2 (%)	IC4	0.01	51.6	49.7	2.65%	60.2	58.5	2.03%
TiO_2 (%)	IC4	0.005	0.54	0.545	0.65%	0.595	0.605	1.18%
Al_2O_3 (%)	IC4	0.01	17	17.4	1.64%	14.1	14.7	2.95%
Fe_2O_3 (%)	IC4	0.01	6.7	7.07	3.80%	10.8	11.4	3.82%
MnO (%)	IC4	0.01	0.23	0.26	8.66%	0.14	0.15	4.88%
MgO (%)	IC4	0.01	6.77	7.21	4.45%	3.44	3.56	2.42%
K_2O (%)	IC4	0.01	3.38	3.31	1.48%	3.62	3.78	3.06%
CaO (%)	IC4	0.01	3.63	4.31	12.1%	0.25	0.28	8.00%
Na_2O (%)	IC4	0.01	1.36	1.42	3.05%	0.03	0.04	20.2%
P_2O_5 (%)	IC4	0.01	0.11	0.1	6.73%	0.14	0.09	30.7%
LOI (%)	IC4	0.01	7.16	7.75	5.60%	5.38	6.11	8.98%
Cr (ppm)	IC4	20	110	130	11.8%	195	205	3.54%
Sc (ppm)	IC4	5	25	25	0%	30	30	0.00%
V (ppm)	IC4	20	185	195	3.72%	255	260	1.37%
Ba (ppm)	IC4M	10	1515	1600	3.86%	2070	1860	7.56%
Be (ppm)	IC4M	0.5	1.5	1.5	0%	1	1	0%
Bi (ppm)	IC4M	3	<3	<3		<3	<3	
Ce (ppm)	IC4M	1	55	60	6.15%	48	43	7.77%
Co (ppm)	IC4M	15	20	20	0%	30	30	
Cs (ppm)	IC4M	3	8	8	0%	4	6	28.3%
Ga (ppm)	IC4M	1	15	18	12.9%	14	13	5.24%
Hf (ppm)	IC4M	1	3	3	0%	2	2	0%
In (ppm)	IC4M	0.5	<0.5	<0.5		0.5	<0.5	
La (ppm)	IC4M	1	28	31	7.19%	26	22	11.8%
Mo (ppm)	IC4M	2	<2	<2		<2	4	
Nb (ppm)	IC4M	10	<10	<10		<10	<10	
Rb (ppm)	IC4M	0.5	100	125		120	115	
Sb (ppm)	IC4M	1	7	10		6	5	
Sn (ppm)	IC4M	10	<10	<10		<10	<10	
Sr (ppm)	IC4M	5	100	140		15	15	
Ta (ppm)	IC4M	2	<2	<2		<2	<2	
Te (ppm)	IC4M	5	<5	<5		<5	<5	
Th (ppm)	IC3M	0.1	8.5	10		6	6	
Tl (ppm)	IC4M	0.5	4.8	4.9	1.46%	2.9	2.6	7.71%
U (ppm)	IC4M	0.5	2.5	2.5		2	2	
W (ppm)	IC4M	3	4	4	0%	4	4	0%
Y (ppm)	IC4M	1	23	28	13.9%	18	18	0%
Zr (ppm)	IC4M	15	95	120	16.4%	65	65	0%
Dy (ppm)	IC4R	0.5	5.5	4.5	14.1%	3.5	4	9.43%
Er (ppm)	IC4R	1	3	3	0%	2	2	0%
Eu (ppm)	IC4R	0.5	1	1	0%	1	1	0%
Gd (ppm)	IC4R	1	4	4	0%	3	3	0%
Ho (ppm)	IC4R	0.5	1	1	0%	0.5	1	47.1%
Lu (ppm)	IC4R	0.5	<0.5	<0.5		<0.5	<0.5	
Nd (ppm)	IC4R	0.5	27.5	22.5	14.1%	21.5	21.5	0%
Pr (ppm)	IC4R	1	7	6	10.9%	5	5	0%
Sm (ppm)	IC4R	0.5	5	4.5	7.44%	4	4.5	8.32%
Tb (ppm)	IC4R	0.5	1	0.5	47.1%	<0.5	0.5	
Tm (ppm)	IC4R	1	<1	<1		<1	<1	
Yb (ppm)	IC4R	1	3	3	0%	2	2	0%
Ag (ppm)	IC3E	1	<1	<1		<1	<1	
As (ppm)	IC3E	3	60	60	0%	55	75	21.8%
Cu (ppm)	IC3E	2	38	39	1.84%	250	275	6.73%
Ni (ppm)	IC3E	2	22	23	3.14%	60	65	5.66%
Pb (ppm)	IC3E	5	30	40	20.2%	175	110	32.3%
Zn (ppm)	IC3E	2	190	210	7.07%	8130	7175	8.82%

The standard deviation (%) is calculated as the standard deviation of the two samples, divided by the average of the samples and reported as a percentage.

Sulfur analyses were carried out separately at the University of Tasmania using an Eltra CS-2000 elemental analyser. This allows for accurate analysis of sulfur and carbon down to the ppm range. A 100-300 mg sample was taken from each pulp sample and weighed into a ceramic crucible with 1.2 g of W chips and 0.6 g of Fe fillings to act as accelerants during combustion within an induction furnace. The sample is combusted at ~2000°C in a pure (99.99%) oxygen stream, causing sulfur to react to sulfur dioxide (SO_2), and carbon to form carbon dioxide (CO_2). The gas is passed from the induction furnace through a series of purification columns where any moisture in the combustion gas is removed by magnesium perchlorate and oxidated sulfur dioxide to sulfur trioxide (SO3) is removed with cellulose wool. The gases, in turn, are passed into the detection unit to determine C and S content. Housed within this unit are four IR- cells calibrated for different sensitivities (high/ low C and high/low S, respectively).

The machine was calibrated for optimal output using the Eltra supplied standards, international standards (AR-4007, AR-4019, Choice Analytical) and internal standard (QLDSED). Precision based on repeat analyses was better than 0.05% C and 0.03% S. Analyses carry standard errors of 0.02% C and 0.005% S, attributed to minor contributions from the accelerants used.

A1.3 Research Samples – Previous Studies

Most of the samples that originated from research studies at the University of Tasmania were crushed in a tungsten-carbide mill and analysed by XRF for the major elements and a combination of S, As, Ba, Bi, Ce, Cr, Cu, La, Nb, Nd, Ni, Pb, Rb, Sc, Sr, Th, V, Y, Zn, and Zr at the University of Tasmania (Jack, 1989; Sharpe, 1991; Gemmell and Large, 1992; Bradley, 1997; Stanley and Gemmell, 1998; Fulton 1999; Gemmell and Fulton, 2001). Some studies require lower detection limits of other elements such as Ag, Bi, Cd, Cs, Mo, Sb, Tl, and U. These elements were analysed by ICP-MS at Analabs in Perth (Fulton, 1999). A small number of samples (~5) from Corbett and Komyshan (1989) were analysed by the geochemistry lab at Mineral Resources Tasmania in Launceston.

A1.4 Historic Aberfoyle Resources and Exploration Samples

Most samples submitted by Aberfoyle for geochemistry were either hand samples of diamond drill core (10-20 cm) or core grind intervals (<1 m to 20 m). The longest core grind intervals are mostly shale sequences and minor massive lava units either in the hanging wall or in the regional areas of the Que Hellyer district. For historic Aberfoyle geochemical data Si, Al, Fe, Ti, Mg, Ca, Na, K, Mn, P, Zr, Cr and Ba were assayed by XRF while Cu, Pb, Zn, Ag and As were assayed by three acid digest with AAS. A total of 501 of these samples are used in this study. Most analyses were carried out by Analabs in Burnie, Tasmania, but very limited details of the analytical methods are provided in the historic company documents with the assay certificates. The various analytical procedural codes commonly used are summarised below for reference.

GA101 & GA102 – perchloric acid digest, AAS finish
GA104 – perchloric, nitric, hydrochloric and hydrofluoric acid digest
GA140 – Aqua Regia/Perchloric acid digest, AAS finish
GX401 - pressed powder XRF
OX408 - Glass fusion XRF
OM615 – Loss on ignition gravimetric

Appendix II – Whole-rock Geochemical Data (this thesis)

A2.0 Whole-rock Geochemical Data

Whole-rock geochemical data collected for this thesis is presented in the follow tables. Samples were analysed as per procedures described in Appendix I Section A1.2.

Sample ID	Unit	Method	Detection Limit	HL589-12	HL589-14	HL589-15	HL589-17	HL589-18	HL589-19	HL673-05
Locality				Fossey	Fossey	Fossey	Fossey	Fossey	Fossey	Fossey
Hole ID				HL0589	HL0589	HL0589	HL0589	HL0589	HL0589	HL0673
Depth				189.8	203.2	218.2	233.3	241.6	247.7	132.6
SiO2	%	IC4	0.01	54.1	61.2	65.9	51.7	64.8	64.6	73.8
TiO2	%	IC4	0.005	0.495	0.54	0.59	0.585	0.575	0.56	0.355
Al2O3	%	IC4	0.01	14.8	14.3	14.9	15.3	14.6	15.7	9.56
Fe2O3	%	IC4	0.01	10.8	6.88	2.55	8.24	6.71	4.98	2.67
MnO	%	IC4	0.01	0.14	0.1	0.05	0.16	0.06	0.05	0.01
MgO	%	IC4	0.01	5.39	3.08	1.16	3.88	2.9	2.2	0.86
K2O	%	IC4	0.01	2.04	1.11	3.32	2.23	3.32	4.65	3.33
CaO	%	IC4	0.01	3.45	2.94	3.03	6.86	0.5	0.7	0.63
Na2O	%	IC4	0.01	1.45	3.96	2.14	2.41	1.19	0.38	0.09
P2O5	%	IC4	0.01	0.3	0.1	0.14	0.18	0.11	0.12	0.04
BaO	%	from Ba		0.074	0.032	0.052	0.050	0.060	0.087	3.016
LOI	%	IC4	0.01	6.3	4.44	4.35	8.29	4.41	4.5	3.34
Total				99.34	98.68	98.18	99.88	99.23	98.53	97.70
C	%	Eltra	1 (ppm)	0.80	0.68	0.70	1.47	0.09	0.14	0.12
S	%	Eltra	1 (ppm)	0.22	0.13	0.09	0.07	1.82	1.67	2.28
Cr	ppm	IC4	20	285	165	75	150	85	115	35
Sc	ppm	IC4	5	30	20	20	25	25	25	10
V	ppm	IC4	20	200	130	145	190	185	185	70
Ba	ppm	IC4M	10	665	285	465	445	535	775	27000
Be	ppm	IC4M	0.5	2	2.5	4	2.5	2	2	1.5
Bi	ppm	IC4M	3	<3	<3	<3	14	<3	<3	<3
Ce	ppm	IC4M	1	205	80	65	75	75	65	90
Co	ppm	IC4M	15	30	25	<15	25	25	25	<15
Cs	ppm	IC4M	3	<3	<3	4	<3	4	4	<3
Ga	ppm	IC4M	1	16	16	16	14	16	16	11
Hf	ppm	IC4M	1	3	3	3	3	3	3	2
In	ppm	IC4M	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
La	ppm	IC4M	1	120	43	34	39	37	34	43
Mo	ppm	IC4M	2	3	<2	5	<2	<2	<2	2
Nb	ppm	IC4M	10	10	<10	<10	<10	<10	<10	<10
W	ppm	IC4M	3	4	<3	<3	<3	8	4	10
Y	ppm	IC4M	1	20	20	17	24	21	22	14
Zr	ppm	IC4M	15	130	115	125	110	110	110	75
Rb	ppm	IC4M	0.5	80	41.5	110	85	130	175	125
Sb	ppm	IC4M	1	4	1	<1	13	6	6	37
Sn	ppm	IC4M	10	<10	<10	<10	<10	<10	<10	<10
Sr	ppm	IC4M	5	80	140	55	160	30	25	290
Ta	ppm	IC4M	2	<2	<2	<2	<2	<2	<2	<2
Te	ppm	IC4M	5	<5	<5	<5	<5	<5	<5	<5
Th	ppm	IC4M	0.5	23.5	11	12.5	10	9.5	9.5	7
Tl	ppm	IC3M	0.1	0.6	0.4	1.1	0.8	1.2	2.1	14
U	ppm	IC4M	0.5	25	6	5	5	3.5	3	3
Dy	ppm	IC4R	0.5	4.5	4	3.5	4	4	4.5	3
Er	ppm	IC4R	1	3	3	2	3	3	3	2
Eu	ppm	IC4R	0.5	3	1	1	1.5	1	1.5	16
Gd	ppm	IC4R	1	7	4	4	4	5	4	4
Ho	ppm	IC4R	0.5	1	1	0.5	1	1	1	0.5
Lu	ppm	IC4R	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Nd	ppm	IC4R	0.5	85	34	30.5	31	33	31.5	34
Pr	ppm	IC4R	1	25	10	8	8	9	8	9
Sm	ppm	IC4R	0.5	12	5.5	5	5.5	5.5	5.5	5
Tb	ppm	IC4R	0.5	1	0.5	<0.5	0.5	0.5	0.5	<0.5
Tm	ppm	IC4R	1	<1	<1	<1	<1	<1	<1	<1
Yb	ppm	IC4R	1	2	3	2	3	3	3	2
Ag	ppm	IC3E	1	<1	<1	<1	<1	<1	<1	2
As	ppm	IC3E	3	20	18	12	26	60	55	105
Cu	ppm	IC3E	2	485	120	50	125	90	75	50
Ni	ppm	IC3E	2	70	24	11	29	26	22	8
Pb	ppm	IC3E	5	50	10	15	10	65	50	375
Zn	ppm	IC3E	2	345	120	90	90	125	560	175

Sample ID	Unit	HL673-07	HL673-09	HL673-11	HL673-12	HL673-13	HL673-14	HL673-15	HL683-13	HL683-15
Locality		Fossey	Fossey	Fossey	Fossey	Fossey	Fossey	Fossey	Fossey	Fossey
Hole ID		HL0673	HL0673	HL0673	HL0673	HL0673	HL0673	HL0673	HL0683	HL0683
Depth		144.3	169.9	191.9	193.5	204.2	222.9	243.3	190.9	218.2
SiO2	%	51.2	53.4	53.6	58.2	72.2	62.7	54.7	76.2	56
TiO2	%	0.86	0.89	0.615	0.625	0.405	0.585	0.585	0.34	0.44
Al2O3	%	21.5	22	17.6	17.6	12.3	17.5	16.8	9.02	12.2
Fe2O3	%	8.44	5.75	7.06	6.44	4.64	5.64	6.64	5.44	6.71
MnO	%	0.02	0.01	0.14	0.16	0.01	0.01	0.22	0.01	0.21
MgO	%	1.41	1.3	1.58	4.03	0.99	1.12	3.62	0.51	2.1
K2O	%	7.26	6.94	5.89	4.76	3.89	5.35	4.52	2.71	4.5
CaO	%	0.21	0.32	3.34	1.16	0.19	0.18	4.26	0.1	7.09
Na2O	%	0.1	0.07	0.11	0.07	0.07	0.08	0.08	0.04	0.12
P2O5	%	0.06	0.18	0.1	0.08	0.08	0.09	0.08	0.02	0.09
BaO	%	0.750	0.841	0.435	0.294	0.157	0.309	0.148	0.233	0.790
LOI	%	7.52	7.29	7.25	5.53	4.42	6.01	6.86	4.31	8.81
Total		99.33	98.99	97.72	98.95	99.35	99.57	98.51	98.93	99.06
C	%	0.03	0.03	0.78	0.24	0.03	0.03	1.01	0.02	1.54
S	%	6.35	4.31	5.05	0.52	3.39	4.21	2.11	4.05	3.76
Cr	ppm	185	100	145	90	140	75	190	185	90
Sc	ppm	35	30	25	30	20	25	30	15	20
V	ppm	255	230	205	215	140	205	255	115	140
Ba	ppm	6715	7525	3895	2630	1405	2770	1325	2090	7075
Be	ppm	3.5	3	3.5	3	1.5	2.5	3.5	1	2
Bi	ppm	<3	<3	<3	<3	<3	<3	<3	<3	<3
Ce	ppm	85	105	60	55	41	65	46	42	55
Co	ppm	35	35	30	25	20	25	80	20	15
Cs	ppm	4	6	6	6	6	4	6	<3	4
Ga	ppm	22	23	16	16	11	16	15	9	11
Hf	ppm	4	5	3	3	2	3	2	1	2
In	ppm	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
La	ppm	45	55	30	29	22	33	23	21	27
Mo	ppm	2	<2	3	<2	<2	<2	<2	2	<2
Nb	ppm	10	10	<10	<10	<10	<10	<10	<10	<10
W	ppm	10	16	6	4	6	6	<3	4	<3
Y	ppm	28	35	25	25	14	22	17	12	19
Zr	ppm	170	185	115	110	75	115	80	60	80
Rb	ppm	240	220	220	175	140	185	170	95	155
Sb	ppm	38	49	17	16	4	4	4	14	10
Sn	ppm	<10	<10	<10	<10	<10	<10	<10	<10	<10
Sr	ppm	25	80	85	30	15	25	55	15	180
Ta	ppm	<2	<2	<2	<2	<2	<2	<2	<2	<2
Te	ppm	<5	<5	<5	<5	<5	<5	<5	<5	<5
Th	ppm	14.5	17	9.5	8.5	6.5	10	6	5	6.5
Tl	ppm	19	13.5	11	8.5	4.2	6	3.8	7	6.5
U	ppm	5.5	6	3.5	3	2	3	2	2.5	2
Dy	ppm	5	6.5	5	4.5	2.5	4	3.5	2	3.5
Er	ppm	3	4	3	3	2	3	2	1	2
Eu	ppm	5.5	7	3.5	2.5	1.5	2.5	2	1.5	4.5
Gd	ppm	5	7	5	4	3	4	3	2	4
Ho	ppm	1	1.5	1	1	0.5	1	0.5	<0.5	0.5
Lu	ppm	<0.5	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Nd	ppm	36	48.5	28	27	19	26.5	20.5	17.5	23
Pr	ppm	10	13	7	7	5	7	5	5	6
Sm	ppm	6.5	9	5.5	5	3.5	4.5	4	3	4
Tb	ppm	1	1	1	0.5	<0.5	0.5	0.5	<0.5	0.5
Tm	ppm	<1	<1	<1	<1	<1	<1	<1	<1	<1
Yb	ppm	3	4	3	3	2	3	2	1	2
Ag	ppm	3	3	<1	<1	<1	<1	<1	<1	<1
As	ppm	355	270	355	55	65	95	75	80	310
Cu	ppm	90	95	70	85	28	43	49	33	65
Ni	ppm	35	30	31	26	20	23	60	23	18
Pb	ppm	95	90	55	15	25	55	25	540	80
Zn	ppm	135	265	55	230	55	60	60	85	125

Sample ID	Unit	HL683-16	HL683-17	HL683-18	HL688-03	HL688-05	HL688-07	HL688-09	HL691-02	HL691-05
Locality		Fossey	Fossey	Fossey	Fossey	Fossey	Fossey	Fossey	Fossey	Fossey
Hole ID		HL0683	HL0683	HL0683	HL0688	HL0688	HL0688	HL0688	HL0691	HL0691
Depth		233.4	247.1	266.2	143.3	168.2	188.8	210.6	176.6	195.4
SiO2	%	52.5	59.7	54.3	67.2	51.1	56.6	61.5	62	56
TiO2	%	0.49	0.56	0.68	0.34	0.63	0.7	0.565	0.445	0.56
Al2O3	%	15	17.2	17.2	15.5	16.1	19.9	16.6	11.4	15
Fe2O3	%	9.95	4.68	9.71	5.87	6.43	3.38	5.52	12.1	11.2
MnO	%	0.2	0.11	0.31	0.04	0.25	0.11	0.16	0.1	0.18
MgO	%	1.67	1.68	5.58	0.73	3.24	1.99	3.1	3.77	4.57
K2O	%	5.37	5.92	3.69	2.45	3.81	4.2	1.27	0.21	0.39
CaO	%	4.01	2.6	1.18	0.74	7.66	4.02	3.16	0.68	1.11
Na2O	%	0.07	0.51	0.12	5.55	0.48	3.31	5.01	3.44	5.18
P2O5	%	0.08	0.09	0.08	0.08	0.16	0.12	0.1	0.05	0.04
BaO	%	0.197	0.219	0.101	0.211	0.220	0.161	0.132	0.020	0.034
LOI	%	9.37	6.37	6.9	2.33	9.4	6.17	3.18	5.58	5.27
Total		98.91	99.64	99.85	101.04	99.48	100.66	100.30	99.80	99.53
C	%	0.98	0.59	0.25	0.03	1.74	0.99	0.20	0.09	0.17
S	%	7.33	2.95	2.09	1.98	0.44	0.32	0.21	3.23	4.19
Cr	ppm	145	85	420	20	195	150	230	325	220
Sc	ppm	20	20	35	15	30	30	25	20	20
V	ppm	170	195	290	40	215	235	195	130	165
Ba	ppm	1765	1960	900	1890	1970	1440	1185	180	300
Be	ppm	2	2	1.5	2	2	2.5	2	1	2
Bi	ppm	<3	<3	<3	20	<3	<3	<3	<3	<3
Ce	ppm	55	60	48	80	60	65	65	95	75
Co	ppm	25	20	40	<15	20	20	20	50	30
Cs	ppm	10	6	6	<3	6	4	<3	<3	<3
Ga	ppm	14	16	15	14	14	16	14	12	13
Hf	ppm	2	3	2	4	3	3	3	2	2
In	ppm	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
La	ppm	27	31	25	41	29	32	31	55	39
Mo	ppm	2	2	<2	5	2	<2	<2	16	6
Nb	ppm	<10	<10	<10	<10	<10	<10	<10	<10	<10
W	ppm	4	<3	<3	<3	<3	<3	<3	<3	<3
Y	ppm	18	25	24	25	22	26	22	14	18
Zr	ppm	90	110	75	145	100	125	105	120	90
Rb	ppm	220	245	130	50	125	160	33.5	9	14.5
Sb	ppm	34	20	7	26	18	9	6	65	4
Sn	ppm	<10	<10	<10	<10	<10	<10	<10	<10	<10
Sr	ppm	75	100	30	370	100	115	395	95	255
Ta	ppm	<2	<2	<2	<2	<2	<2	<2	<2	<2
Te	ppm	<5	<5	<5	<5	<5	<5	<5	<5	<5
Th	ppm	7.5	9	6	18.5	8.5	9.5	9	12	7.5
Tl	ppm	8.5	5.5	4.1	7	8	5.5	1.3	4	0.6
U	ppm	2.5	3	2	12	3	3.5	3.5	8	3.5
Dy	ppm	3.5	4	4	5	4.5	4.5	4	3	3
Er	ppm	2	3	3	3	3	3	2	1	2
Eu	ppm	2	2	1.5	2	2	1.5	1.5	1.5	1
Gd	ppm	4	4	4	5	4	5	4	4	4
Ho	ppm	0.5	1	1	1	1	1	1	<0.5	0.5
Lu	ppm	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Nd	ppm	23	24.5	22	32.5	28.5	27.5	26.5	35.5	28
Pr	ppm	6	7	6	9	7	7	7	10	8
Sm	ppm	4.5	4.5	4	6	5.5	5.5	5	6	5
Tb	ppm	0.5	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5
Tm	ppm	<1	<1	<1	<1	<1	<1	<1	<1	<1
Yb	ppm	2	3	3	3	3	3	2	1	2
Ag	ppm	1	1	<1	<1	<1	<1	<1	3	1
As	ppm	510	355	95	65	32	24	28	195	28
Cu	ppm	70	75	105	29	75	41	60	110	100
Ni	ppm	30	22	90	7	25	25	24	115	36
Pb	ppm	100	25	25	15	165	65	75	85	135
Zn	ppm	50	55	150	60	170	100	155	185	220

Sample ID	Unit	HLD961-12	HLD961-14	HLD961-15	HLD961-16	HLD961-17	HLD961-18	HLD961-21	HLD961-22	HLD961-25
Locality		Fossey	Fossey	Fossey	Fossey	Fossey	Fossey	Fossey	Fossey	Fossey
Hole ID		HLD0961	HLD0961	HLD0961	HLD0961	HLD0961	HLD0961	HLD0961	HLD0961	HLD0961
Depth		170.2	184.8	193.2	204.7	220.2	234.1	261.8	271.5	304.0
SiO2	%	71.2	69.3	60.6	71.5	54.7	78.5	69.7	77.8	51.1
TiO2	%	0.455	0.28	0.28	0.5	0.715	0.345	0.43	0.31	0.555
Al2O3	%	11.5	8.02	6.49	11.9	18	9.96	10.8	7.87	16.5
Fe2O3	%	6.34	10	14.7	4	9.77	3.65	6.3	5.07	6.34
MnO	%	0.01	<0.01	0.01	0.03	0.02	0.01	0.12	0.02	0.27
MgO	%	0.83	0.67	0.56	0.8	1.11	0.57	2.72	0.64	4.19
K2O	%	3.48	2.53	2.13	3.76	5.82	3.11	2.8	2.4	4.27
CaO	%	0.22	0.17	0.25	2.24	0.72	0.17	0.51	0.28	6.38
Na2O	%	0.11	0.04	0.03	0.05	0.26	0.05	0.05	0.04	0.09
P2O5	%	0.01	0.08	0.03	0.16	0.11	0.05	0.03	0.02	0.1
BaO	%	0.948	0.861	2.625	0.430	1.173	0.209	0.180	0.447	0.143
LOI	%	5.36	6.7	9.27	5.22	7.89	3.47	4.96	4.17	7.39
Total		100.46	98.65	96.97	100.59	100.29	100.09	98.60	99.07	97.33
C	%	0.04	0.03	0.07	0.46	0.15	0.03	0.13	0.06	1.43
S	%	5.07	7.85	12.59	2.91	7.55	2.85	3.48	4.10	3.78
Cr	ppm	135	325	175	230	145	200	175	170	115
Sc	ppm	15	10	10	15	25	15	20	10	25
V	ppm	125	95	110	95	205	115	150	95	195
Ba	ppm	8485	7710	23500	3850	10500	1870	1610	4000	1280
Be	ppm	1	1.5	1.5	1.5	1.5	2	1	1	2.5
Bi	ppm	<3	4	4	<3	<3	<3	<3	<3	<3
Ce	ppm	44	19	27	75	70	44	40	44	60
Co	ppm	20	<15	15	<15	25	<15	15	<15	20
Cs	ppm	4	8	<3	4	4	4	4	<3	8
Ga	ppm	12	8	8	12	16	9	9	9	14
Hf	ppm	2	<1	<1	3	3	1	1	1	2
In	ppm	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
La	ppm	22	10	15	39	37	23	20	23	31
Mo	ppm	3	2	3	3	6	2	<2	<2	<2
Nb	ppm	<10	<10	<10	<10	<10	<10	<10	<10	<10
W	ppm	12	8	10	6	8	4	4	4	<3
Y	ppm	17	12	7	24	24	14	11	11	23
Zr	ppm	90	50	50	115	125	70	70	60	105
Rb	ppm	125	100	75	125	175	105	115	90	175
Sb	ppm	9	14	45	31	55	10	5	50	8
Sn	ppm	<10	<10	<10	<10	<10	<10	<10	<10	<10
Sr	ppm	70	80	210	50	165	20	20	35	65
Ta	ppm	<2	<2	<2	<2	<2	<2	<2	<2	<2
Te	ppm	<5	<5	<5	<5	<5	<5	<5	<5	<5
Th	ppm	7.5	4.5	4	10.5	11.5	5.5	5.5	5.5	9
Tl	ppm	4.8	3.9	31.5	7.5	15	4	3.9	4.7	3.7
U	ppm	3	2	2	3.5	4	2	2	2	2.5
Dy	ppm	3	2	1	4	4.5	2.5	2	2	4
Er	ppm	2	1	<1	2	3	1	1	1	2
Eu	ppm	6	5	14.5	3.5	7.5	1.5	1	2.5	1.5
Gd	ppm	3	2	1	5	5	3	2	2	4
Ho	ppm	<0.5	<0.5	<0.5	0.5	1	<0.5	<0.5	<0.5	1
Lu	ppm	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Nd	ppm	18.5	8	10	30.5	30.5	15.5	17	18	23.5
Pr	ppm	5	2	3	8	9	5	5	5	7
Sm	ppm	3.5	1.5	1.5	5.5	5.5	3	3	3	4.5
Tb	ppm	<0.5	<0.5	<0.5	0.5	0.5	<0.5	<0.5	<0.5	0.5
Tm	ppm	<1	<1	<1	<1	<1	<1	<1	<1	<1
Yb	ppm	2	1	<1	2	3	1	1	1	2
Ag	ppm	1	3	9	2	2	<1	<1	2	<1
As	ppm	135	260	495	200	430	85	48	255	95
Cu	ppm	42	55	110	36	65	47	25	200	60
Ni	ppm	19	19	19	12	26	18	25	11	24
Pb	ppm	165	2310	2445	110	195	55	35	7080	65
Zn	ppm	330	1625	6260	170	170	220	80	4415	100

Sample ID	Unit	HLD961-26	FUD16-09	FUD16-13	FUD16-20	FUD16-27	FUD16-30	FUD16-32	FUD16-33	FUD17-04
Locality		Fossey	Fossey	Fossey	Fossey	Fossey	Fossey	Fossey	Fossey	Fossey
Hole ID		HLD0961	FUD0016	FUD0016	FUD0016	FUD0016	FUD0016	FUD0016	FUD0016	FUD0017
Depth		312.9	60.8	98.3	114.9	153.6	174.3	184.1	186.6	75.8
SiO2	%	58	56.3	51.5	59.6	65.5	48.2	53.3	62.6	59.1
TiO2	%	0.475	0.54	0.785	0.44	0.455	0.51	0.57	0.33	0.645
Al2O3	%	15	16.6	18.4	10.5	13.9	19.7	17.1	10.3	15.9
Fe2O3	%	5.07	7.95	10.2	12.5	7.76	5.61	9.87	11	9.92
MnO	%	0.25	0.18	0.04	0.03	0.03	0.38	0.23	0.1	0.13
MgO	%	4.4	5.67	0.88	0.47	1.71	1.26	3.31	0.79	4.45
K2O	%	3.92	2.95	9.41	6.11	4.17	6.29	4.49	3.5	3.5
CaO	%	3.92	2.64	0.7	0.52	0.21	7.17	3.53	2.76	0.45
Na2O	%	0.04	1.7	0.91	0.24	0.05	0.06	0.14	0.03	0.6
P2O5	%	0.07	0.06	0.11	0.15	0.08	0.01	0.09	0.08	0.12
BaO	%	0.097	0.074	0.702	0.662	0.106	0.171	0.121	0.094	0.083
LOI	%	6.41	5.82	7.12	7.26	6.13	8.25	7.73	7.25	5.32
Total		97.65	100.48	100.76	98.48	100.10	97.61	100.48	98.83	100.22
C	%	1.06	0.65	0.12	0.08	0.04	1.60	0.86	0.66	0.09
S	%	2.49	0.39	7.59	9.64	5.11	3.94	4.01	7.84	2.22
Cr	ppm	135	115	40	35	65	135	175	250	325
Sc	ppm	20	35	35	15	25	35	40	25	35
V	ppm	160	265	440	140	175	245	285	170	275
Ba	ppm	865	665	6285	5925	945	1530	1085	840	745
Be	ppm	2.5	1	0.5	<0.5	0.5	2	3	1	2
Bi	ppm	<3	<3	<3	<3	<3	<3	<3	<3	<3
Ce	ppm	50	42	60	29	39	31	49	17	55
Co	ppm	15	30	30	20	<15	30	40	30	35
Cs	ppm	6	4	4	<3	8	8	8	4	6
Ga	ppm	13	16	13	6	13	20	19	11	14
Hf	ppm	2	3	4	2	3	2	2	1	2
In	ppm	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
La	ppm	26	21	30	15	21	15	24	8	29
Mo	ppm	<2	<2	2	<2	<2	<2	<2	2	<2
Nb	ppm	<10	<10	<10	<10	<10	<10	<10	<10	<10
W	ppm	<3	6	14	10	6	8	4	4	4
Y	ppm	22	16	28	14	14	19	20	21	21
Zr	ppm	95	65	90	50	80	60	80	50	75
Rb	ppm	150	90	220	115	130	190	170	140	105
Sb	ppm	10	6	32	41	5	16	16	12	7
Sn	ppm	<10	<10	<10	<10	<10	<10	<10	<10	<10
Sr	ppm	55	55	110	50	20	100	60	40	20
Ta	ppm	<2	<2	<2	<2	<2	<2	<2	<2	<2
Te	ppm	<5	<5	<5	<5	<5	<5	<5	<5	<5
Th	ppm	7.5	6	9.5	5	7	5	6.5	3.5	7.5
Tl	ppm	3.3	1.6	6	6.5	2.6	3.7	2.8	2.8	2.8
U	ppm	2.5	2	3	2	2	1.5	2	1	2.5
Dy	ppm	3.5	3	6.5	4	3	4	3.5	3.5	4
Er	ppm	2	2	3	2	2	2	2	2	2
Eu	ppm	1.5	1	1	0.5	0.5	1	1	0.5	1
Gd	ppm	4	3	5	3	2	3	3	3	4
Ho	ppm	0.5	0.5	1	0.5	0.5	1	0.5	0.5	1
Lu	ppm	<0.5	<0.5	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Nd	ppm	20	18.5	32	17	18	14.5	19.5	9	27.5
Pr	ppm	6	5	8	4	4	3	5	2	7
Sm	ppm	4	3.5	6.5	4	3.5	3	3.5	2.5	5
Tb	ppm	0.5	<0.5	1	0.5	<0.5	<0.5	0.5	<0.5	0.5
Tm	ppm	<1	<1	<1	<1	<1	<1	<1	<1	<1
Yb	ppm	2	2	3	2	2	2	2	2	2
Ag	ppm	<1	<1	2	5	<1	2	<1	2	2
As	ppm	175	65	380	600	185	140	95	490	44
Cu	ppm	65	115	420	710	80	115	150	105	175
Ni	ppm	20	49	30	22	17	39	55	46	100
Pb	ppm	190	70	680	2280	195	70	35	120	2955
Zn	ppm	395	220	1625	14500	1055	190	75	70	4765

Sample ID	Unit	FUD17-07	FUD17-10	FUD17-14	FUD17-16	FUD17-17	FUD17-19	HLD1017-06	HLD1017-08	HLD1017-14
Locality		Fossey	Fossey	Fossey	Fossey	Fossey	Fossey	Fossey	Fossey	Fossey
Hole ID		FUD0017	FUD0017	FUD0017	FUD0017	FUD0017	FUD0017	HLD1017	HLD1017	HLD1017
Depth		92.8	113.8	143.1	154.8	168.2	178.2	201.2	214.4	237.9
SiO2	%	57.3	60.2	21.4	69.4	52.6	57.5	60.8	60	73.1
TiO2	%	0.58	0.595	0.675	0.365	0.785	0.465	0.34	0.555	0.35
Al2O3	%	12.6	14.1	15.6	11.2	18.7	15.2	11.2	17.9	10.6
Fe2O3	%	6.5	10.8	25.9	7.75	9.74	7.37	8.44	6.47	5.14
MnO	%	0.24	0.14	0.4	0.05	0.05	0.29	0.12	0.04	0.02
MgO	%	0.8	3.44	17.3	2.49	1.63	4.5	0.73	2.33	0.41
K2O	%	2.73	3.62	0.37	3.18	6.98	3.27	3.35	5.63	5.97
CaO	%	8.49	0.25	0.25	0.21	0.74	3.46	4.96	0.28	0.37
Na2O	%	3.07	0.03	0.01	0.06	0.16	0.57	0.8	0.05	0.13
P2O5	%	0.27	0.14	0.1	0.1	0.18	0.06	0.09	0.12	0.06
BaO	%	1.419	0.231	0.026	0.141	0.422	0.152	0.099	0.175	0.401
LOI	%	5.5	5.38	17.1	5.97	8.02	7.04	8.84	6.36	3.25
Total		99.50	98.93	99.13	100.92	100.01	99.88	99.77	99.91	99.80
C	%	1.70	0.04	0.04	0.04	0.14	0.88	1.05	0.03	0.07
S	%	4.40	2.71	13.86	4.85	6.07	0.48	6.04	3.78	3.05
Cr	ppm	25	195	155	245	175	55	50	200	50
Sc	ppm	15	30	25	20	20	25	20	30	15
V	ppm	155	255	205	155	290	205	135	210	145
Ba	ppm	12700	2070	235	1260	3775	1365	890	1565	3590
Be	ppm	1	1	<0.5	0.5	1.5	1	<0.5	1.5	<0.5
Bi	ppm	<3	<3	8	4	6	<3	<3	<3	<3
Ce	ppm	60	48	43	25	65	33	33	70	37
Co	ppm	15	30	25	15	30	30	15	20	<15
Cs	ppm	<3	4	4	4	6	10	<3	8	<3
Ga	ppm	10	14	18	13	18	17	10	20	11
Hf	ppm	2	2	3	2	2	2	2	3	2
In	ppm	<0.5	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
La	ppm	31	26	23	12	33	17	16	36	19
Mo	ppm	6	<2	3	3	4	<2	<2	<2	<2
Nb	ppm	<10	<10	<10	<10	<10	<10	<10	<10	<10
W	ppm	6	4	10	6	12	4	4	8	4
Y	ppm	23	18	18	14	19	17	18	22	14
Zr	ppm	80	65	105	70	95	65	70	115	55
Rb	ppm	70	120	12	110	250	125	105	205	150
Sb	ppm	20	6	11	4	4	5	14	8	39
Sn	ppm	<10	<10	<10	<10	<10	<10	<10	<10	<10
Sr	ppm	250	15	15	25	45	65	80	15	50
Ta	ppm	<2	<2	<2	<2	<2	<2	<2	<2	<2
Te	ppm	<5	<5	<5	<5	<5	<5	<5	<5	<5
Th	ppm	9.5	6	9.5	6	8	5	6	9.5	5.5
Tl	ppm	3.3	2.9	0.5	1.8	3.5	1.8	4	6.5	5.5
U	ppm	4	2	3	1.5	2.5	1.5	2	2.5	1.5
Dy	ppm	5	3.5	4	2.5	4	2.5	3.5	3.5	2.5
Er	ppm	3	2	2	2	2	2	2	2	2
Eu	ppm	1.5	1	0.5	<0.5	1	0.5	0.5	0.5	0.5
Gd	ppm	5	3	3	2	4	2	3	4	2
Ho	ppm	1	0.5	1	0.5	1	0.5	0.5	1	0.5
Lu	ppm	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Nd	ppm	32.5	21.5	19.5	10.5	24.5	12	15.5	24	15.5
Pr	ppm	7	5	5	3	6	3	4	7	4
Sm	ppm	8.5	4	3.5	2.5	5	2.5	3	4.5	3.5
Tb	ppm	1	<0.5	<0.5	<0.5	0.5	<0.5	0.5	0.5	<0.5
Tm	ppm	<1	<1	<1	<1	<1	<1	<1	<1	<1
Yb	ppm	2	2	2	2	2	2	2	3	1
Ag	ppm	3	<1	2	<1	2	<1	<1	1	1
As	ppm	340	55	370	135	160	50	235	130	105
Cu	ppm	115	250	65	27	85	110	48	27	110
Ni	ppm	10	60	29	17	30	25	17	27	11
Pb	ppm	1190	175	370	170	585	75	625	230	145
Zn	ppm	1710	8130	2315	210	985	285	595	190	105

Sample ID	Unit	HLD1017 -15	HLD1017 -16	HLD1017 -17	HLD1017 -18	HLD1017 -19	HLD1017 -24	HLD1017 -25	HLD1017 -26	HLD1017 -27
Locality		Fossey	Fossey	Fossey	Fossey	Fossey	Fossey	Fossey	Fossey	Fossey
Hole ID		HLD1017	HLD1017	HLD1017	HLD1017	HLD1017	HLD1017	HLD1017	HLD1017	HLD1017
Depth		244.4	255.9	270.1	279.1	287.2	305.4	312.6	316.4	326.1
SiO2	%	74.2	62	57.8	51.6	65.1	16.9	52	73.7	52.6
TiO2	%	0.43	0.675	0.5	0.54	0.38	0.385	0.635	0.38	0.59
Al2O3	%	13.6	16	11.9	17	12	8.54	17.7	10	18
Fe2O3	%	3.01	7.55	11.6	6.7	5.25	23.4	10.4	5.87	11.6
MnO	%	0.01	0.02	0.07	0.23	0.1	0.1	0.11	0.01	0.02
MgO	%	0.79	1.02	1.93	6.77	1.09	4.14	3.84	0.93	1.94
K2O	%	4.29	5.96	4.44	3.38	4.19	1.9	5.22	3.23	5.83
CaO	%	0.18	0.37	1.14	3.63	2.51	0.25	0.39	0.13	0.26
Na2O	%	0.06	0.07	0.19	1.36	0.56	0.04	0.06	0.05	0.06
P2O5	%	0.09	0.22	0.1	0.11	0.06	0.14	0.15	0.06	0.12
BaO	%	0.115	0.498	1.407	0.169	0.566	0.386	0.304	0.192	0.232
LOI	%	3.51	6.27	8.62	7.16	6.01	17.9	8.86	4.66	9.58
Total		100.29	100.65	99.70	98.65	97.82	74.08	99.67	99.21	100.83
C	%	0.03	0.03	0.25	0.94	0.65	0.09	0.06	0.03	0.05
S	%	1.95	5.48	8.54	2.27	3.82	25.64	7.45	4.55	8.27
Cr	ppm	220	35	25	110	50	125	130	270	80
Sc	ppm	20	20	20	25	30	15	40	20	30
V	ppm	155	270	205	185	135	115	240	140	245
Ba	ppm	1030	4455	12600	1515	5065	3455	2720	1720	2080
Be	ppm	1	1	1	1.5	1	0.5	1	0.5	1
Bi	ppm	<3	<3	10	<3	<3	<3	<3	<3	4
Ce	ppm	44	60	15	55	22	35	75	28	75
Co	ppm	<15	25	25	20	<15	<15	20	<15	20
Cs	ppm	6	4	4	8	<3	4	8	4	10
Ga	ppm	14	17	11	15	10	20	16	11	21
Hf	ppm	2	2	2	3	2	2	3	2	3
In	ppm	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
La	ppm	23	31	7	28	11	15	36	13	40
Mo	ppm	2	<2	<2	<2	<2	13	<2	5	2
Nb	ppm	<10	<10	<10	<10	<10	<10	<10	<10	<10
W	ppm	4	4	6	4	6	<3	10	4	10
Y	ppm	20	20	12	23	16	16	25	9	20
Zr	ppm	80	75	55	95	70	75	115	65	105
Rb	ppm	135	205	150	100	120	75	195	115	205
Sb	ppm	14	7	9	7	14	650	12	12	38
Sn	ppm	<10	<10	<10	<10	<10	20	<10	<10	<10
Sr	ppm	15	45	180	100	105	35	35	20	40
Ta	ppm	<2	<2	<2	<2	<2	<2	<2	<2	<2
Te	ppm	<5	<5	<5	<5	<5	<5	<5	<5	<5
Th	ppm	7.5	6.5	5	8.5	5.5	7	10.5	5.5	9
Tl	ppm	2.6	5.5	5.5	4.8	8	10	8.5	5	13
U	ppm	2	3	2	2.5	2	2	3	2	3.5
Dy	ppm	4	4	2.5	5.5	3	2.5	5	2	4
Er	ppm	2	2	1	3	2	2	3	1	3
Eu	ppm	1	1	<0.5	1	1	<0.5	1	<0.5	1.5
Gd	ppm	3	4	2	4	2	3	5	2	4
Ho	ppm	1	1	0.5	1	0.5	0.5	1	<0.5	1
Lu	ppm	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Nd	ppm	23	24.5	8.5	27.5	10.5	13.5	34	13	31
Pr	ppm	5	6	2	7	3	4	9	3	8
Sm	ppm	4	5	4	5	3	3	6.5	2	5.5
Tb	ppm	0.5	0.5	<0.5	1	<0.5	<0.5	1	<0.5	0.5
Tm	ppm	<1	<1	<1	<1	<1	<1	<1	<1	<1
Yb	ppm	2	2	1	3	2	2	3	1	2
Ag	ppm	<1	1	3	<1	1	70	<1	1	1
As	ppm	55	225	245	60	215	3180	90	175	545
Cu	ppm	55	60	90	38	26	6570	20	42	46
Ni	ppm	13	23	21	22	18	14	34	19	25
Pb	ppm	240	110	320	30	170	67300	100	565	135
Zn	ppm	150	70	2035	190	210	155500	135	795	55

Sample ID	Unit	MCD35-05	MCD35-07	MCD35-09	MCD35-11	MCD35-13	MCD35-15	MCD35-16	MCD35-17
Locality		Mount Charter	Mount Charter	Mount Charter	Mount Charter	Mount Charter	Mount Charter	Mount Charter	Mount Charter
Hole ID		MCD35	MCD35	MCD35	MCD35	MCD35	MCD35	MCD35	MCD35
Depth		250.0	266.6	288.0	305.6	328.9	335.1	357.9	371.1
SiO2	%	65.5	68.1	71	75.9	71.1	72.3	68.4	73.2
TiO2	%	0.395	0.33	0.365	0.32	0.345	0.33	0.425	0.315
Al2O3	%	15.9	12.9	14.3	12.9	14.2	13.9	11.9	12.5
Fe2O3	%	2.75	4.66	4.28	1.75	3.03	2.63	5.68	2.78
MnO	%	0.02	0.11	0.18	0.04	0.14	0.05	0.14	0.09
MgO	%	0.31	0.96	0.85	0.28	0.26	0.39	0.99	0.48
K2O	%	9.3	3.64	3.91	5.06	7.4	6.13	1.8	2.78
CaO	%	0.37	2.69	0.26	0.16	0.22	0.2	3.95	2.61
Na2O	%	0.2	0.73	1.03	0.77	1.11	1.5	2.92	2.41
P2O5	%	0.08	0.08	0.1	0.12	0.1	0.11	0.17	0.05
BaO	%	0.450	0.091	0.091	0.196	0.249	0.222	0.070	0.103
LOI	%	3.06	4.62	2.97	2.04	1.66	1.71	2.58	3.09
Total		98.33	98.91	99.34	99.54	99.81	99.47	99.02	100.41
C	%	0.07	0.68	0.15	0.05	0.10	0.07	0.87	0.64
S	%	1.68	0.18	0.14	0.21	0.22	0.18	0.03	0.08
Cr	ppm	<20	<20	115	<20	<20	400	<20	<20
Sc	ppm	10	10	15	20	10	10	15	10
V	ppm	30	<20	<20	<20	<20	<20	45	<20
Ba	ppm	4025	815	815	1755	2225	1990	625	920
Be	ppm	1	2.5	2	1.5	1.5	1	2	2
Bi	ppm	<3	<3	<3	<3	<3	<3	<3	<3
Ce	ppm	105	115	65	110	125	36	80	100
Co	ppm	<15	<15	<15	<15	<15	<15	<15	<15
Cs	ppm	<3	4	4	<3	4	4	<3	4
Ga	ppm	16	16	17	14	15	15	12	13
Hf	ppm	5	4	6	5	4	3	3	3
In	ppm	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
La	ppm	55	60	30	55	65	18	46	55
Mo	ppm	5	<2	3	<2	<2	4	<2	<2
Nb	ppm	15	10	15	15	15	15	10	10
W	ppm	10	<3	4	6	6	8	<3	4
Y	ppm	28	30	35	30	30	24	20	19
Zr	ppm	185	165	225	150	170	170	115	130
Rb	ppm	155	120	130	100	155	145	70	90
Sb	ppm	4	3	3	3	3	3	<1	<1
Sn	ppm	<10	<10	<10	<10	<10	<10	<10	<10
Sr	ppm	35	40	20	30	65	50	160	105
Ta	ppm	<2	<2	<2	<2	<2	<2	<2	<2
Te	ppm	<5	<5	<5	<5	<5	<5	<5	<5
Th	ppm	22	17.5	25	17	20.5	19	12.5	15
Tl	ppm	4.1	1.5	1.3	1.6	1.7	1.6	0.6	0.8
U	ppm	14.5	5	6.5	5.5	5.5	5.5	4	4.5
Dy	ppm	6.5	5.5	6	6	5.5	4	4.5	4.5
Er	ppm	3	3	3	3	3	3	3	3
Eu	ppm	2	2	1	1.5	1.5	1	1.5	1.5
Gd	ppm	7	6	5	7	7	3	5	5
Ho	ppm	1	1	1	1	1	1	1	1
Lu	ppm	<0.5	<0.5	0.5	0.5	0.5	<0.5	<0.5	<0.5
Nd	ppm	48.5	42	28.5	48	48	16.5	38.5	49
Pr	ppm	12	11	7	13	14	4	8	10
Sm	ppm	9	8	5	8.5	8.5	3.5	7.5	9
Tb	ppm	1	1	1	1	1	0.5	0.5	0.5
Tm	ppm	<1	<1	<1	<1	<1	<1	<1	<1
Yb	ppm	3	3	3	3	3	3	2	2
Ag	ppm	1	<1	<1	<1	<1	<1	<1	<1
As	ppm	60	18	10	28	34	14	<3	4
Cu	ppm	5	4	4	9	4	5	19	3
Ni	ppm	3	<2	<2	<2	<2	4	<2	<2
Pb	ppm	35	20	15	20	25	20	10	5
Zn	ppm	41	70	46	37	40	46	50	28

Appendix III – Graphic Logs

A3.1 Graphic Logs

The graphic logging technique used in this study is slightly modified from McPhie et al. (1993). The graphic logs contain five columns for recording the depth, grain size, structure, alteration, and a written description of the rock units. The alteration column is not commonly used in volcanic facies interpretation, but it has been added for the purpose of this study to record the variation in alteration mineralogy by colour and intensity by line styles. Weak alteration intensities are denoted by dashed lines with more closely spaced dashes indicating stronger (i.e., moderate) alteration intensity. Solid lines refer to strong alteration intensities and thick solid lines indicate intense alteration of that mineral (by colour).

Alteration Colours:

- Sericite – light purple
- Chlorite – dark green
- Quartz – orange
- Carbonate – light blue
- Epidote – light green

Mineralisation Colours

- Pyrite – red
- Barite – dark purple
- Sphalerite – brown
- Galena – dark blue

Common abbreviations used in the graphic logs and rock descriptions are:

Alteration Minerals:

- Qtz = Quartz
- Ser = Sericite
- Chl = Chlorite
- Alb = Albite
- Kspar, ksp = K-feldspar
- Carb = Carbonate

Sulfide and Sulfate Minerals

- Py = Pyrite
- Sphal, sph = Sphalerite
- Gal = Galena
- Cpy = Chalcopyrite
- Ba = Barite

An example of a graphic log is included in the following pages. Scanned copies of all the Fossey, Fossey East, and Mount Charter drill logs are available electronically in this appendix.

Hole ID: HLD 961 | Depth: 314.2 m | Date: 23 Apr 2010 | Page: 1 of 7

Location: 10200 N (Fossey) | Azi/Incl.: 275/-56 | Logged by: S. Wu

Lithology: S. Wu samples SR Nov 09

Depth (m)	Grain Size (mm) 0.06 0.5 2 8 32 128	Structure	Alteration	Lithology
0–22.5				Did not log core above 22.5 m due to strong weathering.
22.5–40+ (carb-qtz; qtz)		-24.5-24.6 m: rubbly and oxidized -trace cp in thin carb vein -brecciated/fractured w/ qtz-fsp infill. -brecciated/fractured w/ qtz-fsp infill	Weak pervasive chl ± ser overprinted by moderate patchy qtz-fsp hydrothermal brecciation. Late carb-qtz veins	Fine grained basaltic unit w/ weak chl altⁿ. Faint darker spots ~0.5 mm may be chl altered ferromagnesian crystals (?). Rare conc. of white specks may be fsp crystals. Unit is moderately carb-qtz vein. Patchy qtz-fsp altⁿ is common where the unit appears to be fractured and infilled by grey f.g. silica w/ a pale pink fsp altⁿ halo in basalt or commonly as pink fsp altered clasts within qtz veins/patches.
40–50 (pink fsp alt; basalt clasts; qtz matrix)		-small zones of brecciation, infill mostly white f.g. qtz w/ carb and remobilized chl	-weak chl w/ weak fsp or qtz alt?? qtz-carb veinlets and irregular clots (2-4 mm)	-unit is weakly altered by fsp or qtz. Original textures are blurred but rk is still quite hard

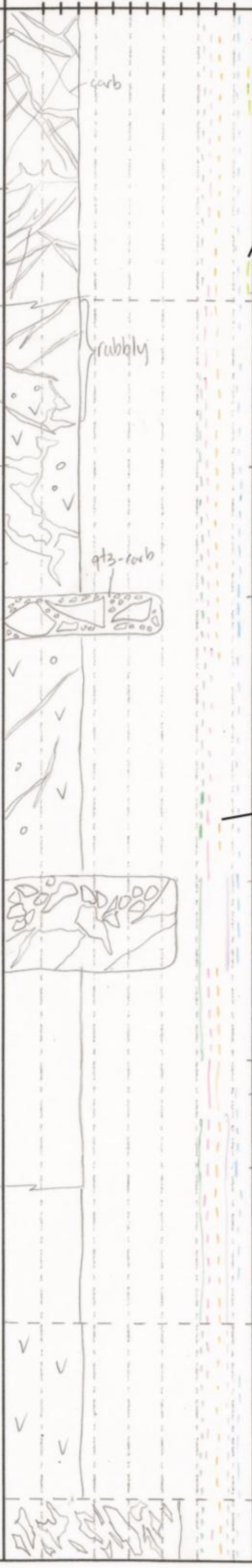
30.15-30.44 m 23/04/10

48.44-48.69 m 23/04/10

Hole ID: HLD 961 | Depth: 214.2m | Date: 23-Apr 2010 | Page: 2 of 7

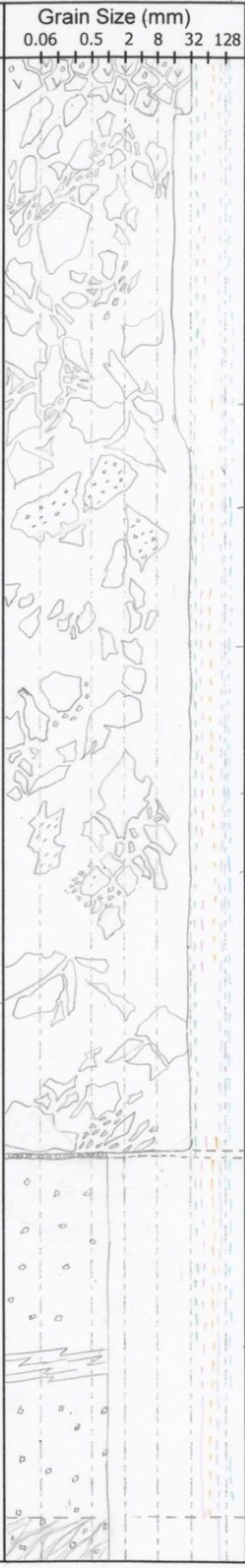
Location: 10200 N (Fossey) | Azi/Incl.: 275/-56° | Logged by: S.Wu

Grain Size (mm): 0.06 0.5 2 8 32 128



Depth (m)	Structure	Alteration	Lithology
50 qtz-carb; carb-qtz-epi	51.0-59.5m mod veined carb qtz ±epi, sometimes patchy	Weak background chl w/ overprinting mod, patchy pinkish grey fsp-qtz carb-qtz ± epi veining or infill	Same unit, can see small white specks of possibly fsp crystals ~10% < 0.5mm and occasional sections where 1-2mm chl-altered laths may be mafic crystals.
	@59.5m fault contact (?)	59-62m: strong to mod pervasive pink fsp ± qtz	Likely a fault ~59.5m
60 carb-qtz-epi	carb-qtz-epi veins ~35° TCA	weak background chl w/ weak pervasive grey fsp altⁿ(?) carb-qtz ± epi veins still common	Med greenish grey basaltic unit, f.g. similar to unit above, but w/ 5-10% 1-5mm elongated carb amygdales (sometimes replaced by dark green chl) 64.10-64.34m 23/04/10
70	matrix supported hydrothermal breccia	weakly fsp altered section, minor carb ± qtz veins	brecciated section: clasts are angular (some w/ curviplanar edges - deformation?)
			 6cm
			lack of amygdales, oblitorated by altⁿ?
80	fault breccia? fractured rk w/ carb infill	mod-strong chl-ser heavily veined fractured by carb	clast- to matrix supported breccia matix mostly carb. Clasts are strongly chl-ser. altered
	qtz-carb veins 2-40mm ~70° TCA	mod chl (-ser?) w/ overprinting fsp + qtz cross cut by qtz-carb veins	near major fault, rocks are v. altered and varies from mod chl(-fsp?) to strong, patchy pinkish grey fsp-qtz. Pates of pinkish grey altⁿ sometimes look like clasts as ser-chl surrounds them and they are often mod carb ± qtz veined (0.5-1mm). Fractures have smooth undulating planes sub // TCA. 82.60-82.82m 23/04/10
	tension gashes? 0.5-2mm (~80° TCA) qtz ± carb; 10-15cm wide carb vein 20° TCA; fault gouge ~10cm. mixed w/ sandy disintegrating rk	strong domainal ser-chl, patchy fsp-qtz, rk fragile	
90	@92.3m gradational contact?		
	Qtz-carb veining common (esp. ~94m) Minor cpy w/ veins 93.5-94m	weak to mod pervasive chl-ser(?) w/ minor patches of pink fsp-qtz	Med grey f.g. basaltic unit w/ weak to mod altⁿ. Fractures are chl + cal rich and there's trace cpy minz in some qtz-carb veins ~94m. No obvious phenos or vesicles 93.44-93.81m 26/04/10
100	@98.0m Approx contact (veined & broken)	Clasts are chl(-ser?) altered and matrix	

Hole ID: HLD 961	Depth: 214.2m	Date: 26 April 2010 Page: 3 of 7
Location: 10200 N (Fossey)	Azi/Incl.: 275/-56°	Logged by: S. Wu



Depth (m)	Structure	Alteration	Lithology
100	jigsaw fit breccia ~100-102m	weak chl-ser(?) clasts w/ carb ± qtz matrix; hyaloclastite(?) matrix ser-carb ± fsp(?)	Med grey monomict clastic unit w/ angular and wispy clasts of chl (-ser?) altered basalt. Clast size range from 2-40mm and appears to be matrix-supported (70% clasts). Matrix is f.g. light grey ser-carb ± fsp altered. Some clast boundaries have pink fsp alt^{n}. @100-102 Unit appears more coherent (carb and chl amygdales present) but unit is fractured (hydralic?) w/ carb ± qtz infills
110	2.5cm qtz-carb vein ~50° TCA; 0.3-3cm qtz-carb ± trace cpy 40-50° TCA	mod to strong patchy pink fsp-qtz in matrix (and clasts locally)	@113-116.5m: Clast are larger (up to 25 cm) and fsp & mafic phenos observed in some larger clasts. Matrix strongly altered by orange/pink fsp-qtz.
120	9cm qtz-carb (-epi?); 6-8cm qtz-carb-chl vein 50-60° TCA; 127-129m: 2-15cm qtz-carb veins	light pinkish grey fsp-qtz-carb matrix	Larger clasts are more common (≈ 5-10cm) but there are still lots of small 2-5mm clasts in between. More clast-supported than matrix-supported (~80% clasts). Mafic phenos (needle-like ~ 1-3mm long) observed in some clasts.
130			From 127-136m: Phenos not obvious (maybe due to alt^{n}?)
	@136.36m – @136.43m	weak ser(-chl?) alt^{n} (30cm above is strong pink fsp and lower contact is carb(-chl) veined	136.36-136.43m: Small section of core which appears to be silt to coarse sand sized clastic unit. Grains are round and range from light grey to pink (volcaniclastic?)
140	143-144: fault? strongly cleaved and qtz-carb veined. Rks v. broken up & ser altered. 4cm qtz-carb vein ~35° TCA	mod pink fsp-qtz - v. minor dissem py. w/ domainal ser; 140.5-142.5m: less altered (med grey)	Feldspar-phyric unit originally med grey but mostly altered by ser and fsp-qtz to a light orange grey colour. 15% ~1mm fsp phenos are evenly distributed & suggest a coherent unit. Domainal alt^{n} gives rock a brecciated appearence w/ orange-grey clasts and soft light grey matrix.
150	@148.5m sharp alt^{n} contact	Strong pervasive ser w/ domainal qtz	

109.44-109.76m 26/04/10

121.78-122.13m 26/04/10

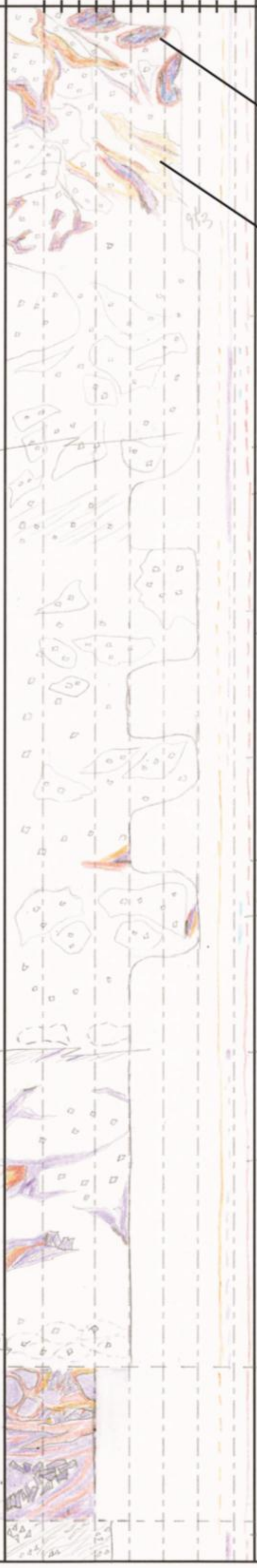
136.36-136.43m Thin Sect. SR Nov09

142.09-142.36m 26/04/10

Hole ID: HLD 961	Depth: 314.2m	Date: 27 Apr 2010	Page: 4 of 7
Location: 10200 N (Fossey)	Azi/Incl.: 275/-56°	Logged by: S.Wu	

Depth (m): 150, 160, 170, 180, 190, 200; py b/w clasts(?)

Grain Size (mm): 0.06, 0.5, 2, 8, 32, 128



Structure

@149m: cleavage ~45°TCA

late carb veins/patches

164.1: fault? 10cm clay/gouge

foliation=40-50° TCA

169.1m: fault? 20cm clay/gouge

small barite vein w/ large 1x2cm crystals

qtz carb vein 4cm 40°TCA

glassy silica vein cut by ba vein w/ sph-py cut by py vein

10 cm ba-qtz vein w/ minor pale sph ± py 40°TCA

fault? 6cm soft clay/gouge

ba vein 2cm 20°TCA

@193.85m Approx. contact (sharp Ba ↑)

(sharp Ba ↓) @198.70m Approx contact

foliation ~ 45°TCA

Alteration

Strong alt^n ± patchy minz makes texture v. difficult to interpret. Trace fuchsite

strong ser w/ overprinting qtz-py; strong domainal (20-30% qtz, 10-15% py)

strong pervasive ser-py w/ weak, domainal qtz-py trace fuchsite

strong ser-py pervasive, phenos highlighted by ser

strong domainal qtz-py, weak ser (pheno alt^n) trace fuchsite

Strong to intense qtz-py (py locally up to 35% of rk) w/ wispy ba veins 0.5-4cm weak ser in some less silicified areas. Trace fuchsite

Intense ± texturally destructive barite-py-qtz

strong to intense ser-py

Lithology

Med grey unit w/ strong texturally destructive ser alt^n and overprinted by qtz-py (-ba?). Barite v. fg. Pods of sphal-gal-ba and lesser b/w "clasts" assoc. w/ qtz-py veins/clots. Most minz b/w 150-158 m.

@158m: Unit relatively less altered by still quite altered and has a brecciated appearance due to domainal alt^n. Both clasts and matrix have ser or py replaced fsp phenos (pseudo breccia?)

@163.5m: py ↑ and concentrate in "clasts" (30-90%)

some parts of the unit look less brecciated (b/c less altered?)

qtz

py (~90%)

glassy silica (w/ 10% dissem py)

184m: right after fault ~30cm is strongly foliated w/ 0.5-1cm bands of py-qtz and py-ser. Two 0.3cm bands of barite w/ minor sphal(?)

Somewhat coherent section of fsp-phyric unit ser alt^n largely overprinted by qtz-py but some fsp phenos preserved & are evenly distributed. Wispy ba veins & patches add to textural complexity but appear to be after qtz-py and have coarse lathy crystals. V. minor sphal

Light to med grey barite zone w/ 65-85% barite, 15-30% py and

151.25-151.44m 27/04/10

153.95-154.00m Thin Section 29/04/10

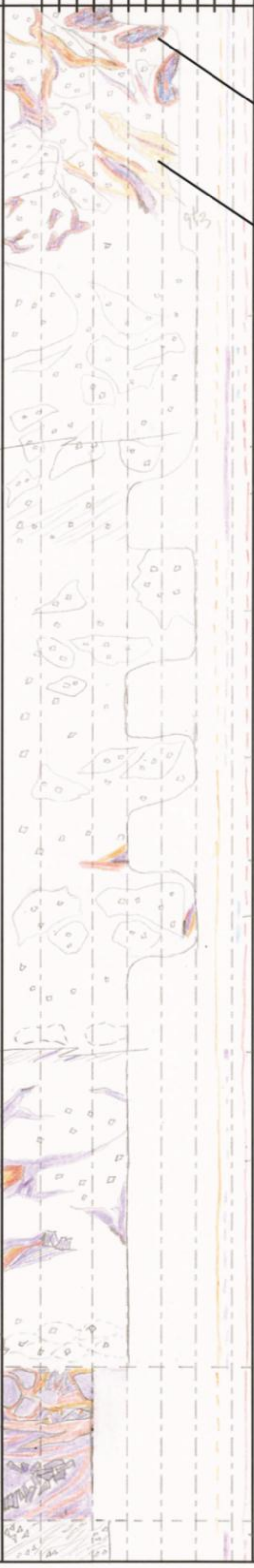
170.04-170.26m 27/04/10

177.73-177.90m 28/04/10

184.61-184.91m 27/04/10

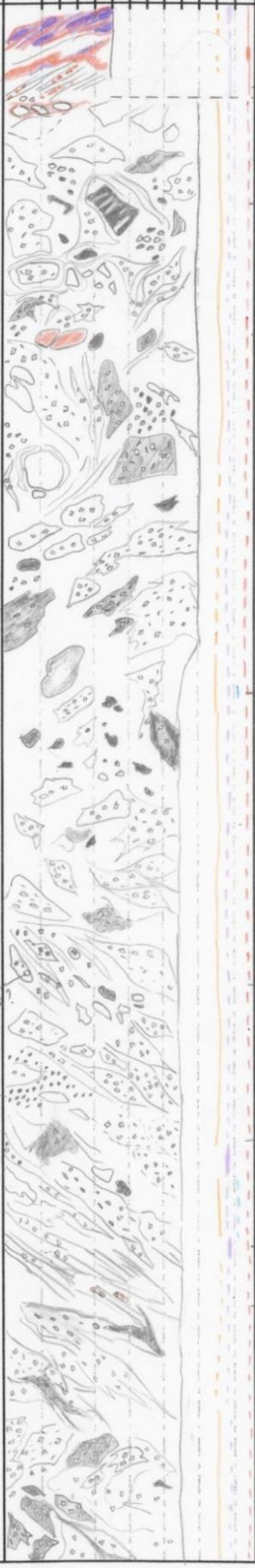
193.00-193.39m 29/04/10

Hole ID: HLD 961
Location: 10200 N (Fossey)
Depth: 314.2m
Azi/Incl.: 275/-56°
Date: 27 Apr 2010
Page: 4 of 7
Logged by: S.Wu

Depth (m)	Grain Size (mm) 0.06 0.5 2 8 32 128	Structure	Alteration	Lithology	
150		@149m: cleavage ~45°TCA	Strong altn & poddy minz makes texture v. difficult to interpret. Trace fuchsite	Med grey unit w/ strong texturally destructive ser altn and overprinted by qtz-py (-ba?). Barite v. fg. Pods of sphal-gal-ba and lesser b/w "clasts" assoc. w/ qtz-py veins/clots. Most minz b/w 150-158 m.	151.25-151.44 27/04/10; 153.95-154.00m Thin Section 29/04/10
			strong ser w/ overprinting qtz-py; strong domainal (20-30% qtz, 10-15% py)		
160		late carb veins/patches	strong pervasive ser-py w/ weak, domainal qtz-py trace fuchsite	@158m: Unit relatively less altered by still quite altered and has a brecciated appearance due to domainal altn. Both clasts and matrix have ser or py replaced fsp phenos (pseudo breccia?)	
		164.1: fault? 10cm clay/gouge			
		foliation=40-50° TCA	strong ser-py pervasive, phenos highlighted by ser	@163.5m: py ↑ and concentrate in "clasts" (30-90%)	
170		169.1m: fault? 20cm clay/gouge; small barite vein w/ large 1x2cm crystals		some parts of the unit look less brecciated (b/c less altered?)	170.04-170.26m 27/04/10
		qtz carb vein 4cm 40°TCA	strong domainal qtz-py, weak ser (pheno altn) trace fuchsite	qtz; py (~90%); glassy silica (w/ 10% dissem py)	
		glassy silica vein cut by ba vein w/ sph-py cut by py vein			177.73-177.90m 28/04/10
180		10 cm ba-qtz vein w/ minor pale sph & py 40°TCA			
		fault? 6cm soft clay/gouge	Strong to intense qtz-py (py locally up to 35% of rk) w/ wispy ba veins 0.5-4cm	184m: right after fault ~30cm is strongly foliated w/ 0.5-1cm bands of py-qtz and py-ser. Two 0.3cm bands of barite w/ minor sphal(?)	184.61-184.91m 27/04/10
		ba vein 2cm 20°TCA	weak ser in some less silicified areas. Trace fuchsite	Somewhat coherent section of fsp-phyric unit ser altn largely overprinted by qtz-py but some fsp phenos preserved & are evenly distributed. Wispy ba veins & patches add to textural complexity but appear to be after qtz-py and have coarse lathy crystals. V. minor sphal	
190	py b/w clasts(?)				193.00-193.34m 29/04/10
		@193.85m Approx. contact (sharp Ba ↑)	Intense & texturally destructive barite-py-qtz		
		(sharp Ba ↓) @198.70m Approx. contact		Light to med grey barite zone w/ 65-85% barite, 15-30% py and	
200		foliation ~45°TCA	strong to intense ser-py		

Hole ID: HLD961 | Depth: 314.2m | Date: 29 Apr 2010 | Page: 5 of 7

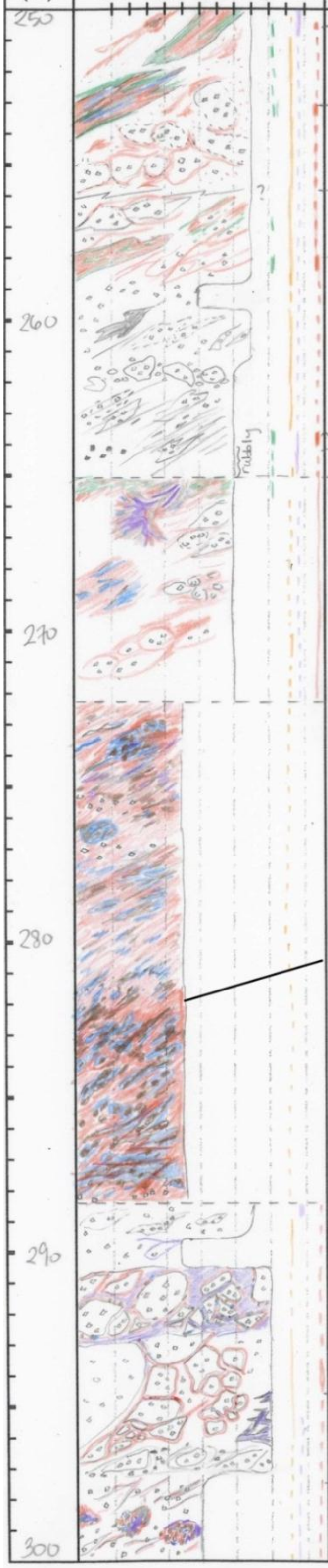
Location: 10200 N (Fossey) | Azi/Incl.: 275/-56 | Logged by: S. Wu

Depth (m)	Grain Size (mm) 0.06 0.5 2 8 32 128	Structure	Alteration	Lithology
200		foliation 50° TCA	ba-py (py wraps around ~ round, wispy barite nodules	1-5% qtz. Barite ranges from ~1.5cm round clasts surrounded by py to f.g. massive w/ clots & wispy veins of py to barite veins and patches w/ lathy crystals (2 by 10mm to 5 by 30mm). Weak banding/fabric b/w barite & py-rich layers. 204.57-204.86m 29/04/10
		7 cm v. ser-clay altered, possible fault	Strong qtz-py w/ weak ser trace fuchsite	
210		py replaced clasts ~2cm		Sharp decrease in barite at 198.7m and immediately below is a v. strongly ser-py altered clastic unit w/ silt to coarse sand-sized grains, foliated and partially replaced by py-ba in some areas.
			more ser altered clasts(?). mod-strong qtz-py overprints ser trace fuchsite	Light grey clastic unit w/ v. strong qtz-py alt^n. Clasts angular/wispy to subrounded ~80% is fsp-phyric w/ ~10% ser or py altered 1-2mm fsp phenos and 5-7% altered 1mm long needle-like mafic phenos. Dark grey clasts are ser-py-qtz altered & f.g. (siltstone??). Clast sizes 3-80mm and mostly matrix supported. Matrix is strongly qtz-py to white/light grey colour and resembles fsp-phyric unit in less altered areas. Clast boundaries are vague sometimes but clasts have different alt^n styles. No suspect rounded siltstone clasts past ~226m. 220.02-220.30m 29/04/10
220		6 cm carb-py vein 20-30° TCA	increase in qtz alt^n clast boundaries more blurry. Lack of large 6-8cm dark clasts.	
230		6cm py-ser vein 60° TCA		233.97-234.23m 30/04/10
carb amygdale?				
v. qtz alt matrix, ser-py alt crystals				
		1 cm qtz vein w/ stringy gal and pale sphal (pinched out)	strong ser	More ser altered zones are more deformed/foliated and fabric wraps around py nodules and sometimes carb veins.
			back to qtz dominated alt^n; 2-10mm wispy carb veins	
240		foliation ~ 60° TCA	strong ser, rk v. soft	
			back to strong qtz-ser-py, trace fuchsite	
		dol vein (1-2cm) weak rxn w/ HCl after scratching		Med to dark grey fsp-phyric clasts due to ser alt^n (w/ trace fuchsite.
				247.76-247.98m 30/04/10
250				

Hole ID: HLD 961 | Depth: 314.2 m | Date: 4 May 2010 | Page: 6 of 7

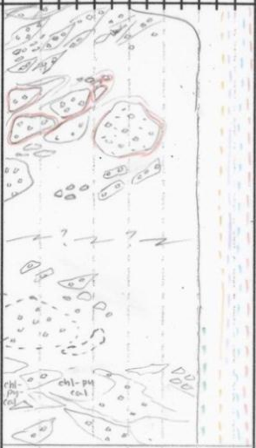
Location: 10200 N (Fossey) | Azi/Incl.: 275/-56° | Logged by: S. Wu

Depth (m) | Grain Size (mm) 0.06 0.5 2 8 32 128



Depth (m)	Structure	Alteration	Lithology	
250–265	-25 cm py-black chl vein -20cm gal-py-chl (-sphal?) -fault(?): gravels cemented by clay(?) -50 cm py-chl vein -30 cm py-chl vein -264-265m: foliated > rubbly	Strong pervasive ser overprinted by strong to intense qtz-py. Py-chl veins common (20-50cm) and some assoc. w/ gal + sphal minz. Late cal ± qtz veins 1-10mm w/ rare pale colour sphal -strong ser w/ overprinting py-chl (esp. phenos)	Strongly altered by ser (150-151m) w/ 20-50 cm thick sections of py-black chl ± gal ± sphal (250.5-260 m) Intense white to light grey qtz-py alt^n w/ minor ser after 151 m. -section is slightly less altered and has a coherent porphyritic texture (~50cm) Unit in general is strongly altered and py veined (~20% 1-2mm ser replaced fsp phenos)	259.04-259.20m 04/05/10 261.74-261.93m 30/04/10 S.R. Jan2010
265–272	@265.1-265.9m: v. rubbly, obscured contact @265.1: 20 cm light orange sph-py-gal w/ ba filled void? Dark grey sph rim w/ ba-sph contact	Strong pervasive py-chl (v. fragile) w/ minor (remnant?) strong qtz alt^n (265.1-265.9m) Strong pervasive qtz-py-ser w/ semi-massive py-sph-gal minz	Med grey clastic fsp-phyric unit w/ strong qtz-py-ser alt^n 40-50% of unit is replaced by py-sph-gal minz (massive locally, sometimes as veins & conc. in matrix) Trace fuchsite. ~10% 1 mm ser and py replaced fsp phenos.	271.43-271.60m 04/05/10
272–288.4	massive sulphide containing pyrite, galena and sphalerite @288.40m Sharp decrease in minz	-high grade blebby (2-3mm) pale orange sphal w/ interstitial gal appears to be replaced by py	Massive sulphide zone w/ pervasive strong py-qtz alt^n which locally shows remnant fsp(?) phenos not replaced by py. Sphal tends to be irregular & blebby w/ ~10% as pale brown clots w/ f.g. interstitial (?) gal (-sph?) black and ba. Some py overprinting of sphal minz. Hard to differentiate f.g. qtz, barite, ser in some areas. Lower half of this section is more sphal- and gal-rich.	SR 09/09 Pb isotope 285.43-285.63 m 04/05/10
288.4–300	ba veins w/ gal+sph -lathy ba crystals (up to 4 cm long) w/ a 2-4 cm v.f.g. silica alt^n halo 3 mm light sphal-py-gal vein	Top 0.5m, strong ser w/ minor fuchsite; then strong & pervasive qtz overprinted / veined by py ba veining & breccia -strong py veining/ alt^n -increase in ser alt^n (mod to strong) and overprinted(?) by mod qtz. trace fuchsite	Med grey fsp-phyric unit w/ 10% 1-2mm ser replaced fsp phenos and ~5% 1mm needle-like altered mafic phenos. Unit has a brecciated appearance at the top (~wispy clasts/alt^n - pseudobreccia) but at 289.6 - 290.3 m unit looks coherent w/ minor ba-py ± gal ± sph (1-10mm) veining. Obvious brecciation starts ~290.5 w/ some wispy clasts & py rims ± gal and sph	

Hole ID: HLD 961	Depth: 314.2m	Date: 5 May 2010	Page: 7 of 7
Location: 10200 N (Fossey)	Azi/Incl.: 275/-56°	Logged by: S. Wu	

Depth (m)	Grain Size (mm) 0.06 0.5 2 8 32 128	Structure	Alteration	Lithology
300 strong qtz alt 310 mod ser alt w/ weak qtz	 chl-py-cal chl-py cal EOH = 314.20m	307-308m: v. rubbly - fault? or just weak b/c ser alt^c?	mod pervasive to domainal ser-py and mod domainal qtz py strong, patchy chl-py-carb over mod pervasive qtz (qtz-ser over chl-py-carb?)	to 290.75 where rounded clasts (1-15cm) are rimmed by py-sph-gal supported by a mostly ba matrix. ~291.7m Clasts are angular w/ jigsaw fit texture (1-3 cm) and altered to a grey v.f.g. silica, Clast also have minor py ± gal + sph rimming. Some recrystalization of ba in matrix to long lathy crystals (~0.5 by 2cm) ~295.4m, unit is more ser altered and less py + ba veined. Unit is still fsp-phyric but has a clastic appearance. Most larger clasts (1-6cm) have a wispy/deformed appearance and smaller ones (1-4mm) are ~equant and angular. Matrix is often hard to differentiate from clasts as it appears to be fsp-phyric as well but more ser-altered and sheared/deformed, wrapping around some clasts. ~297.2m: unit appears to be somewhat coherent Different intensity of ser-py alt^n only gives the unit a mild patchy appearence. Clots of sph-gal-ba-py 5-6 cm wide near 298.8m. ~300m: unit looks somewhat clastic. "Clasts" are sub-rounded to wispy w/ mod ser alt^n and py rimming. "Matrix is more qtz-py altered (over-printing ser?) ~310: ser-py altered "clasts" in more qtz-py altered "matrix" Domainal qtz-py alt^c → pseudo-breccia? ~310.5m: patchy (course grained) texturally destructive chl-py-cal alt^n over mod pervasive qtz possibly qtz-ser after chl-py-cal as some chl altered clasts are in a qtz-ser matrix. Some py rimming on mod qtz altered clasts(?) End of Hole

*SR JAN 10

303.85-304.05m 04/05/10

312.80-313.03m 5/05/10

Appendix IV – Vein Logs

A4.1 Vein Logs

Additional vein logs were produced for some Mount Charter drill holes in order to record detailed observations of the different styles of veining and the crosscutting relationship of the veins. The depth is recorded at the centre/midpoint of the vein and the vein thickness is measured perpendicular to the vein wall. The angle of the vein is measured as the acute angle from the core axis. When possible, the vein paragenesis is recorded by the order of mineralisation such that the first mineral(s) are written first, followed by subsequent minerals(s) as indicated by arrows in the log. The timing of the veins (syn- or post-mineralisation) was not determined at the time of logging and the columns are left blank.

Common abbreviations used in the vein logs and rock descriptions are:

Alteration Minerals:

- Qtz = Quartz
- Ser = Sericite
- Chl = Chlorite
- Alb = Albite
- Fsp = Feldspar
- Kspar, ksp = K-feldspar
- Carb = Carbonate

Sulfide and Sulfate Minerals

- Py = Pyrite
- Sphal, sph = Sphalerite
- Gal = Galena
- Cpy = Chalcopyrite
- Ba = Barite

An example of a vein log is included in the following pages. Scanned copies of all the Mount Charter vein logs are available electronically in this appendix.

Hole ID: MCD 026
Location: Mount Charter
Depth: 119.8 m
Azi/Incl.: 088.6/-58.7°
Date: 21 Feb 2011
Logged by: S Wu
Page: 1 of 2

Depth (m)	Width (mm)	Angle to Core	Vein Type	Contact	Mineralogy	Sph Color	Paragenesis	Alteration into Wallrock	Syn-Min Vein	Post-Min Vein	Remarks
2.83	2-4	irregular	stockwork	diffuse	qtz-py-gal-sph	dark f.g.?	py cubes - blebby gal-sph → qtz	diffuse qtz halo			
3.33	2-4	irregular	stockwork	irregular, diffuse	qtz-ba-py-sph-gal	pale, blk rim	py-sph-gal → qtz-ba	" " "			
4.49	2-4	55-60°	set of 8	sharp	qtz-carb-sph	grey	sph → qtz-carb crystals ⊥ vein wall	minimal			cuts py stringers, soft sugary mineral not reactive w/ HCl → carb?
5.40	400	broken		irregular	carb-qtz-Cu oxide-malachite	—	1.5×2.5 Cu oxide aggregate → carb-qtz	powdery ser-rks			non HCl reactive carb
6.11	4-15	irregular	~stockwork	irregular	qtz-py-ba-gal-sph	dark f.g.?	py wall → py-blebby gal-sph → ba → qtz(?)	thin white qtz halo			
6.75	2	20°		sharp, irregular	py	—	—	none			cut by 55° TCA qtz-carb veins
7.64	125	60°			qtz-carb	—	crystalline qtz → carb	~2cm halo of orange, powdery rk			
9.50	3	30°?		diffuse ~planar	ba-gal	—	gal → ba	~diffuse			cut by qtz-carb veins
10.30	1-2	30°		sharp, irregular	py-qtz	—	—	none			cut by 35° & 75° qtz veins w/ gal & sph at intersection
14.38	1-12	irregular	~stockwork	stringy, undulating	py-qtz-gal-sph	dark	py → gal-sph → qtz	minimal qtz			
15.15	320	irregular		irregular	qtz ± carb	—	—	~2-7cm orange, silicified halo			
17.70	720	irregular		weathered	qtz-carb ± py	—		minimal			py dissolved? stained red-orange
19.54	2-20	irregular	~stockwork	irregular	py-qtz-ba-ser	—	qtz-py (dissem) -ba cut by py-ser (massive)	fuzzy py, ser edges			heavy veining ~breccia
23.94	2	irregular	~stockwork	sharp, irregular	qtz-py	—	py → microcrystalline qtz	minimal			over printed by later py stockwork veins & inter-clast matrix
25.96	3-30	irregular	breccia matrix	sharp, irregular	ba-py-sph-gal	pale, blk rim	py → sph-gal → ba	py ± ba leakage			
26.70	0.5-5	irregular	stringers	stringy, wispy	py-ba-sph-gal	dark	py stringers, some w/ ba-sph gal core or cut py stringers	thin, stringy py leakage			
27.75	10-30	irregular	breccia matrix	irregular	ba-py-sph-gal		py rim on clasts → py-sph-gal → ba	Some py-ba leakage			wispy strips of non-replaced foliated rock
28.54	2-17	30°	~stockwork	fuzzy ~planar	qtz-py-sph	pale, blk rim	py-sph → qtz	ser in wall rks.			sph in some veins only; cut by 65° TCA qtz-gal vein
32.06	4-40	irregular	breccia matrix		ba-py-qtz-sph-gal	pale, blk rim	py → qtz → py-sph-gal → ba	py rimming on clasts			patchy qtz-py in ba rich matrix
33.20	0.5-2	5-20°	stringers	wispy, ~planar	py		—	py leakage			cut by jagged 60° TCA qtz-sph (pale, blk rim) veins
36.07	2-3	20-55°	~stockwork	sharp, irregular	qtz-sph-gal	pale, blk rim	sph-gal → qtz	minimal			
38.09	0.5-2	55°	stringers	wispy, ~planar	ba(?)-py-gal-sph	dark	sph-gal → ba → py overprint?	ser(?) halo, soft & fuzzy			discontinuous stringers in coherent section
39.37	5-37	irregular	breccia matrix	~sharp irregular	ba-py-gal-sph	dark	py rims → py-gal-sph → ba	ser on v. altered clasts			
42.04	2-20	irregular	~stockwork	fuzzy, undulating	qtz-carb-sph	pale, blk rim	blebby & crystalline (grey) sph → crystalline qtz & carb	qtz-sph leakage			
44.27	1-4	~20°	stringer	sharp, wispy	py		—	py leakage			cut by & merged w/ coarse ba vein w/ py-sph
47.41	3-22	irregular	breccia matrix	sharp, irregular	ba-py-sph-gal	pale, blk rim	py rim → sph-py-gal → ba	py rim & softer ser edge			
49.20	2-22	irregular	~stockwork	diffuse, irregular	ba-py-sph-gal	pale, blk rim	py → sph-gal → ba	soft, cream-coloured ser halo			may have cut & incorporated py + qtz veins

Hole ID: MCD 026 Depth: 119.8 m Date: 22 Feb 2011 Page: 2 of 2

Location: Mount Charter Azi/Incl.: 088.6/-58.7° Logged by: S.Wu

Depth (m)	Width (mm)	Angle to Core	Vein Type	Contact	Mineralogy	Sph Color	Paragenesis	Alteration into Wallrock	Syn-Min Vein	Post-Min Vein	Remarks
50.15 53.09	0.5-10 1-4	irregular 65°	stockwork	wispy, irregular sharp ~planar	py ± qtz ba-py-sph	pale	py → qtz in shrinkage shadows py wall → ba-sph	darker qtz halo minimal			sph-gal after vesicles in rk cuts py stringers
55.07 56.44	1-7 3	50-55° 40°	set of 5	sharp planar	qtz-carb(?)-sph-gal py-ba	pale, blk rim	py → ba	none cream coloured ser halo			cuts py stringers
58.39	10-30	irregular			ba-py-sph-gal	pale, blk rim	py wall → sph-gal → ba	minimal			qtz-carb veins appear to terminate against this vein cannot penetrate or ba vein post-date qtz-carb?
60.18	3-15	irregular	local swell	irregular	py-sph-gal	reddish brown		none			local conc of massive py-sph (minor gal) appears to cut qtz-py veins.
62.86 63.80	>30 2-20	irregular irregular	breccia matrix stockwork	irregular	ba-sph-gal-qtz ba-py-sph	pale, dk rim pale	some coarse py → sph-py-gal → ba ± qtz darker py → lighter py → sph rim on light py → ba	py-qtz into clasts py leakage			very blobby replacement 2 phases of py, one lighter, one darker
66.26 68.59	50 5-25	irregular irregular	matrix matrix	irregular, diffuse irregular	ba-py-sph-gal ba-py	pale, dk rim	coarse py → sph-gal → crystalline ba	py leakage, diffuse qtz py rim, ser halo			
69.33 70.07	1-3	45° bulbous	set of 8	sharp, ~planar	qtz-carb-py ba-py		py → qtz-carb ⊥ wall py → ba	py rimming; ba in some vesicle			ba w/ bands of py ~folded
71.87 74.49	3-30 65	irregular 70°	vein/matrix	irregular sharp, irregular	ba-py-gal-sph py-ba-qtz-sph-gal	dk grey	py wall → gal-sph → ba py → sph-gal → ba → qtz	py leakage py, qtz, ser?			ba in vesicles crystalline qtz reopened vein?
77.13 78.18	1-6 3-7	65° irregular		irregular irregular bulbous	ba ba-qtz-sph	pale, dk rim	— qtz "nodules" → sph → ba	brownish halo (qtz?) ~py rimming			cut by 55° TCA qtz-py vein
79.98 80.57	90 190	~70° 50°		irregular irregular	qtz-py-sph-gal ba-py-sph-gal	pale, dk rim pale	py → sph-gal → qtz py-sph-gal → ba	py leakage, ser halo py leakage, ser halo			py-ba displaced by qtz
85.33 87.34	~240 260	42° 35°		~planar ~sharp irregular ~planar	ba-py ba-py-sph-gal	orange	massive py → massive ba py → sph-gal → ba (crystalline)	ser halo py rimmed clasts			bands/streaks of py in ba sph wrapped by gal
99.00 102.74	10 2-12	75° irregular	replacement	sharp, planar irregular/sharp	qtz ba-gal		gal blebs → ba	none minimal			cuts dacite clasts & qtz-py matrix
105.34 108.19	110 3-12	irregular 48°	replacement	sharp, irregular irregular	qtz-gal ba-sph-gal	pale, dk rim	gal → crystalline qtz sph-gal → ba	dark qtz halo ~diffuse towards qtz halo			dissolution cavities → carb? cuts thru breccia matrix
112.78 115.57	0.5-5 1-6	irregular irregular	stockwork stockwork	sharp, irregular " "	py-cal cal-py		py → cal py → cal	minor py leakage thin qtz halo + brown ank stain on wall			py stockwork w/ cal conc. at some intersections cal cutting & using py networks
118.55 119.75	1-13 1-10	irregular irregular	replacement vein	sharp, irregular irregular, wispy	cal ba-sph-gal	pale, dk rim	— sph-gal → ba	brown ank on wall qtz halo; minor py			cal after breccia matrix + fines cuts py stringers but has qtz overprint

Appendix V – Database Compilation Notes and Calculations

A5.0 Introduction

There are a total of 6,772 samples in the newly compiled geochemical database, with 2,558 samples from Aberfoyle Exploration, 707 samples from UTAS, MRT and CISRO, 3,438 samples from Bass Metals, and 69 samples from this thesis. The database is provided electronically in this appendix.

All the major elements that were not previously expressed as oxides were converted to oxides in percentage using the elemental concentration from parts per million. All Fe concentrations have been converted to Fe_2O_3 $_{Total}$. If the major elements MgO, Cao, Na_2O, and K_2O have concentrations below detection limit, their values were replaced with half the detection limit; the procedure was done so that an Alteration Index can be calculated even if one of these major element concentrations approximates zero. Some of the UTAS data have been previously normalised to exclude LOI. Those data were back-calculated to their un-normalised values based on the LOI content. Data from Jack (1989) appear to have been normalised; however, his data were not back-calculated because the method of normalisation is unclear.

Any conversions and calculations that are not from the original datasets are coloured orange within the Excel spreadsheet (in Appendix V, electronically). Data that have been corrected or entered from sources outside of the main Aberfoyle, UTAS, MRT, and Bass Metal databases are in purple. Other previously missing data from *Rock* and *Rock Type* columns were matched from other databases and also entered into the spreadsheet in purple.

A5.1 XRF and ICP-MS/OES Analyses

The Bass Metals dataset has over 3500 samples with more elements analysed than the rest of the dataset (excluding the samples from this thesis). However, the samples were prepared using a four-acid digest and so there are number of elements which may not be fully digested, such as Al, Ba, Be, Cr, K, La, Na, Nb, S, Sc, Se, Ta, Te, Ti, and W. Ten samples from the Bass Metals dataset were selected to be reanalysed by XRF at UTAS to evaluate how the four-acid digest ICP analyses compare with XRF results. The samples were selected to represent a range of lithologies, alteration minerals, Ti/Zr ratios, alteration index (AI) values, Cr, and base metal concentrations.

Using the same sample pulps of the selected Bass Metal samples, major element and selected trace element whole-rock analyses were carried out by Philip Robinson (UTAS analyst) using a PAN analytical Axios Advanced XRF and the methods are outlined in Robinson (2003). Major elements as oxides were determined from discs fused at 1100°C in 5% Au/95% Pt crucibles, with a lithium-metaborate flux. Trace elements were determined from pressed powder pills.

Not all trace elements analysed by ICP have been analysed by XRF but the available ones have been compared and the statistics are tabulated in Table A6.1. Some of the elements that are more widely used in this study for various classifications have been plotted in Figure A6.1 to A6.3.

Most of the elements show reasonably compatible analyses except for BaO, Cr and Y, where ICPMS analyses consistently return much lower values. The correlation between BaO and Y concentrations between the four-acid digest ICPMS and fusion XRF is considered to be too inconsistent for these analyses to be combined and used in conjunction. Barium occurs as barite and also as a minor component in muscovite and K-feldspar. Digestion by mixed acid will capture most of the Ba in the silicates and only a variable amount of Ba in barite due to incomplete dissolution by four-acid digestion (Bill MacFarlane, corporate geochemist at AcmeLabs, Bureau Veritas Groups, pers. comm., September 2013). The problem is compounded in mineralised and strongly altered samples as the excess S in the digest solution re-precipitates Ba as barite, leading to a low bias for Ba in high S samples (Dave Lawie, managing director, ioGlobal, pers. comm., August 2013).

Chromium values between ICPMC and XRF are different but they show good correlation with the ICPMS values being consistently lower than XRF values by almost 50%. The same trend in Cr is observed in an internal study completed by S. Richardson for Bass Metals (November 2012). The study investigated the bias in ICPMS assay values for Ti, Zr, and Cr between the fusion and the four-acid digestion methods in 85 samples. The data shows that fusion digested samples have measured Cr contents about 65% higher than the corresponding four-acid digested samples. A regression curve of $y = 0.0003x^2 + 1.5875x$ provides a reasonable fit to the data and is used to correct for the bias in four-acid digestion ICPMS samples. Richardson's study also finds that Ti and Zr assays by fusion ICPMS are consistently higher than acid digest ICPMS; however, the difference is considered to be minor, about 3% higher for Ti and 9% for Zr. In this study of 10 samples, the TiO_2 and Zr concentrations are 3% and 8% higher in fusion XRF compared to four-acid ICP. Due to the relatively small difference in values, Ti and Zr assays are, therefore, not adjusted.

Table A6.1 – Summary of statistics for the correlation of four acid digest ICPMS data versus XRF analyses.

	ICPMS vs. XRF (y = mx + b)	Correlation coefficient	Comments
Al_2O_3	y = 0.94x - 0.03	0.834	
FeO	y= 0.99x - 0.24	0.999	
MgO	y = 0.95x - 0.004 (y = 0.78x + 0.20)	0.995 (0.833)	Excluding 360511 (using all data points)
MnO	y = 0.86x - 0.004 (y = 0.88x - 0.01)	0.996 (0.939)	Excluding 360511 (using all data points)
CaO	y = 0.95x - 0.004 (y = 0.64x + 0.29)	0.995 (0.944)	Excluding 360511 (using all data points)
Na_2O	y = 0.92x + 0.31 (y = 0.81x + 0.90)	0.988 (0.956)	Excluding 360511 (using all data points)
K_2O	y = 1.03x - 0.04	0.977	
P_2O_5	y = 0.82x + 0.01	0.992	
TiO_2	y = 0.93x + 0.01	0.939	
Zr	y = 1.06x - 15.42 (y = 0.94x - 4.37)	0.963 (0.782)	Excluding 361134 (using all data points)
BaO	y = 0.85x - 0.01 (y = 0.038x + 0.048)	0.997 (0.006)	Excluding 364854,360639, 364995 (using all data points)
Cr	y = 0.53x - 0.60 (y = 0.49x - 4.09)	0.941 (0.825)	Excluding 361134 (using all data points)
Sc	y = 0.76x - 0.96	0.964	
V	y = 0.80x - 1.62	0.939	
Ce	 (y = 0.83x - 6.37)	 (0.581)	Excluding 361134 (using all data points)
Th	y = 0.90x - 0.49	0.776	
Nb	y = 0.88x - 0.39	0.917	
Y	y = 0.55x + 5.76	0.452	
La	y = 0.93x - 5.18	0.731	
Sr	y = 1.11x - 29.99	0.926	
Rb	y = 0.85x - 5.31	0.946	
Co	y = 1.04x - 0.29	0.954	
Ni	y = 0.92x - 1.54	0.875	
Cu	y = 0.96x + 0.15	0.997	
Zn	y = 1.05 x - 14.85	1.000	
As	y = 1.09x + 8.25	0.999	
Mo	y = 0.88x - 0.36	0.922	
Pb	Y = 1.03x - 63.88	1.000	

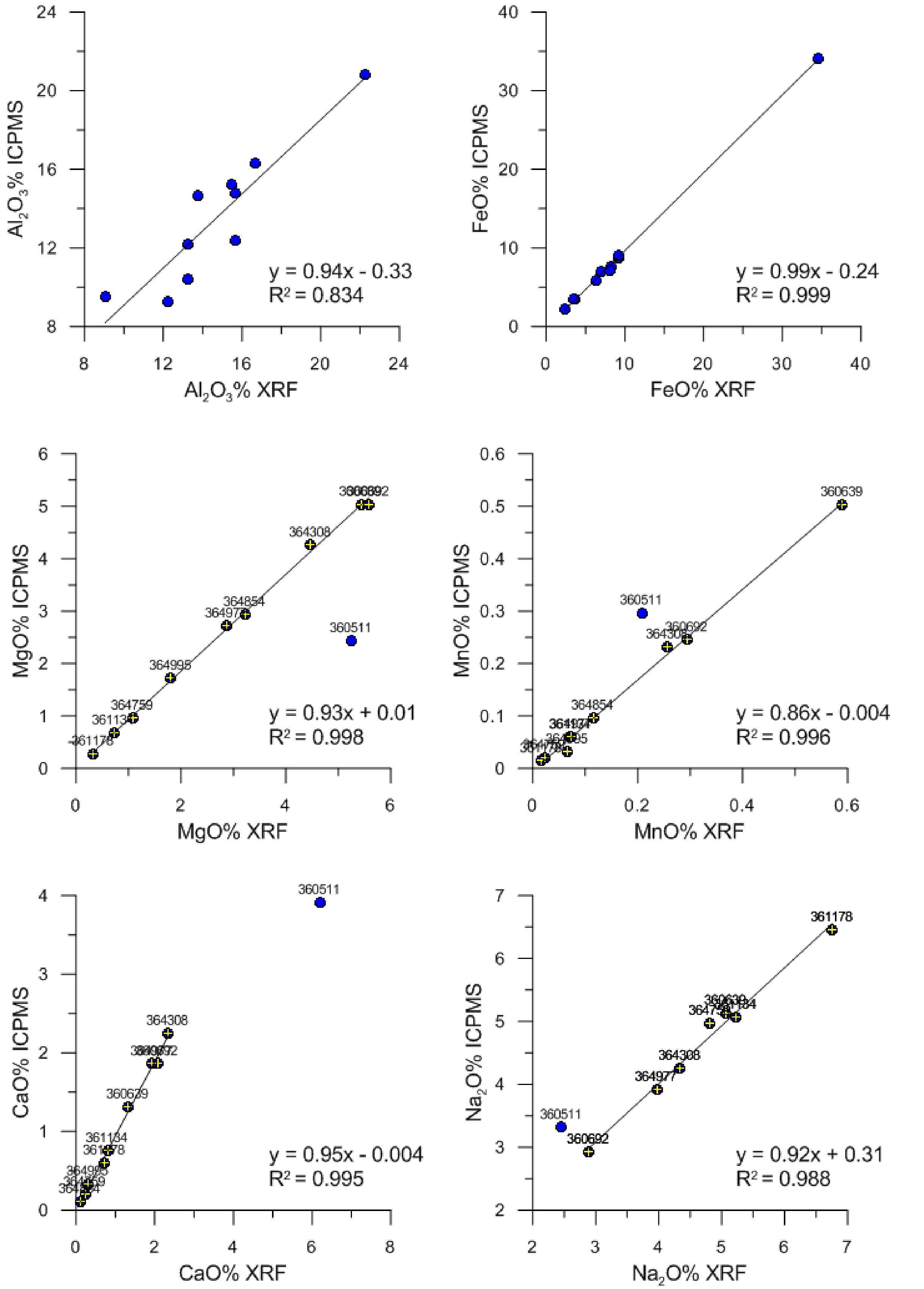


Figure A6.1: Scatter plots of four-acid digest ICPMS data versus XRF analyses for Al_2O_3, FeO, MgO, MnO, CaO and Na_2O concentrations. Linear equation and correlation coefficient, R^2, are calculated for all points except for MgO, MnO, CaO and Na_2O where sample 360511 is excluded.

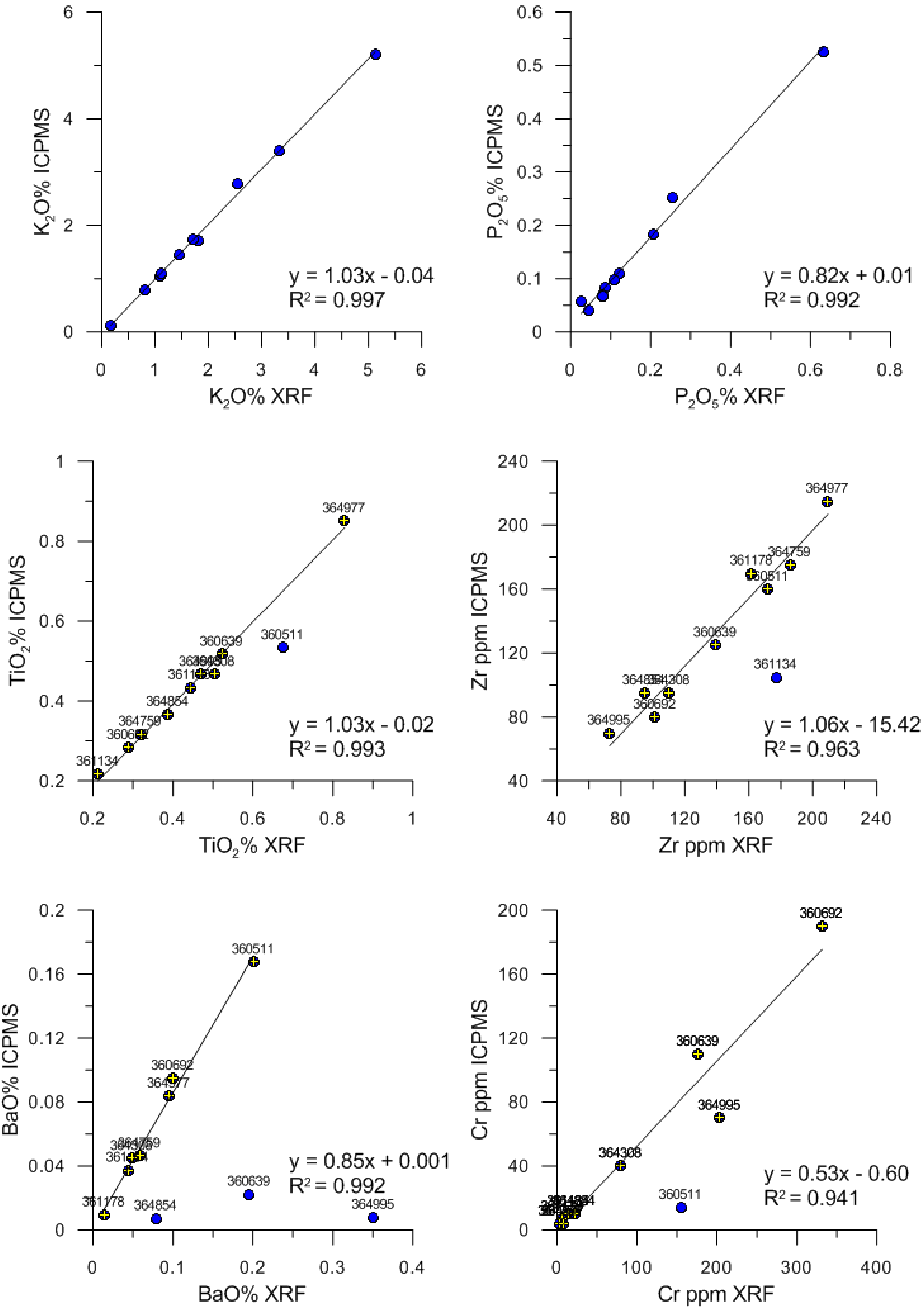


Figure A6.2: Scatter plots of four-acid digest ICPMS data versus XRF analyses for K_2O, P_2O_5, TiO_2, Zr, BaO and Cr concentrations. Linear equation and correlation coefficient, R^2, are calculated for all points except for TiO_2, Zr, BaO and Cr where the blue data points are excluded.

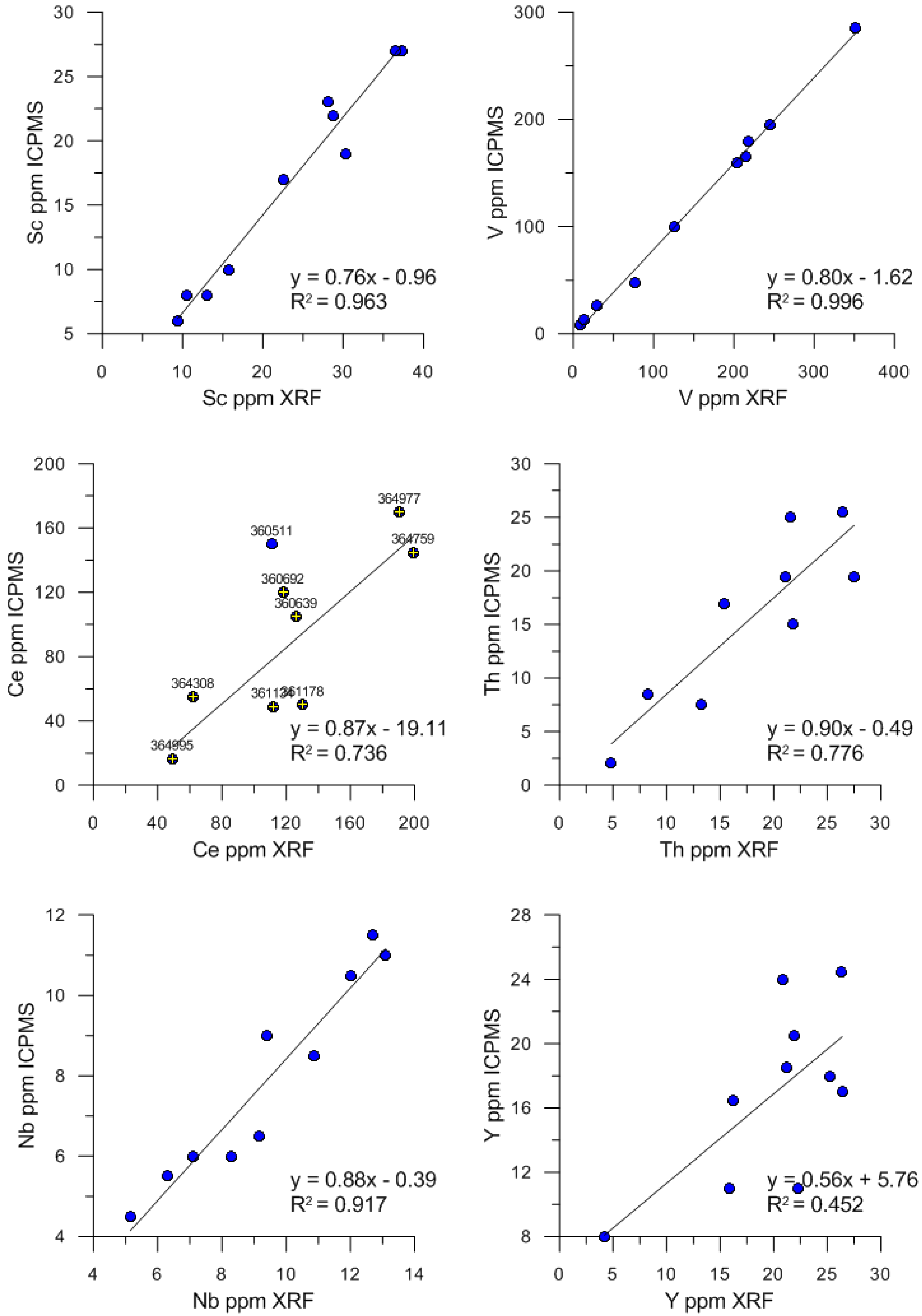


Figure A6.3: Scatter plots of four-acid digest ICPMS data versus XRF analyses for Sc, V, Ce, Th, Nb and Y concentrations. Linear equation and correlation coefficient, R^2, are calculated for all points except for Ce where sample 360511 is excluded.

Other elements that are used in the lithogeochemical classification that report in lower concentrations by ICMPS compared to XRF include P_2O_5, Sc, V, Ce and Th. However, these values are not adjusted at all since the 10-sample comparative study is not comprehensive enough to provide a reliable correction factor for 3000+ samples. Of the 3753 samples classified using multi-element Ti, Zr, Cr, Sc, V, Th, P, and Ce scheme, 3099 samples are from Bass Metals and 654 from a combination of research studies. So the Bass Metals analyses form a large part of the dataset and the Ti, Zr, Cr, Sc, V, Th, P, and Ce concentrations are compared against each other for coherent groupings of data points. Since the four-acid digest ICP and XRF data show high correlation ($R^2 \geq 0.963$; except Ce where $R^2 = 0.736$), adjusting the values by a theoretical correction factor will not alter the groupings severely but it will introduce an unknown amount of error to the dataset.

Although there are inherent problems with regards to four-acid digestion method, the overall results achieved by having a low detection multi-element dataset from 3500+ samples from the QHV still greatly enhanced the knowledge of the primary host rock and alteration chemistry. It is important to note that Ti, Zr, and Cr values are largely comparable between the four-acid digest ICP and XRF datasets and these values can be used to discuss the compatibility of the lithogeochemical classification schemes by multi-element Ti, Zr, Cr, Sc, V, Th, P, Ce and by Ti, Zr, Cr in Chapter 5.

A5.2 Additional Data and Calculations

Stratigraphy Position of Samples ("Strat")

The "*Strat*" column in the spreadsheet denotes the general stratigraphic position of the sample. These have also been coded to a numeric value in the compiled database.

60 – URS
50 – QRS
40 – Hanging Wall Basalt
30 – Mixed Sequence (35 – semi-massive/massive sulphides; 37 – barite)
20 – Footwall Andesite, Feldspar-phyric Sequence
10 – Lower Basalt
5 – Animal Creek Greywacke

Coherency of Samples ("Coherent")

A newly added column *Coherent* is used to classify the coherency of the samples using a simple 1 to 4 scale. A coherency of 4 refers to units that are coherent such as lavas, dykes, and intrusions. Breccias and volcaniclastics that are dominated by one rock type are given a classification of 3. Quellites (historic mine terminology for a sericite-silica-pyrite altered unit) and highly altered units are also included in this group. Polymict breccias and volcaniclastics are classified as 2 and sedimentary units such as mudstones and greywackes are 1. In addition to the 1 to 4 scale, 13 vein samples are coded as 0 and 22 barite and mineralised samples as 5. The numeric coding allows for the selection of samples that are more coherent for each rock type and thus a better constraint on the composition and variations in trace element geochemistry. The monomictic breccias, volcaniclastics, quellites, and highly altered rocks can then be compared to their more coherent counterparts.

Iron in Pyrite Calculations ("Fe_py" and "Fe_no py")

For the samples that have sulfur data, the theoretical amount of Fe locked up in pyrite is estimated by taking the sulfur content (wt. %) of the sample and calculating the amount of Fe (wt. %) that would be required to make up an equivalent amount of pyrite based on a 2:1 Fe/S molar ratio. To account for the presence of other sulfides and sulfates, samples that have Ba, Zn, Pb, and Cu concentrations greater than 0.5% would have their sulfur content allocated first as barite ($BaSO_4$), sphalerite (ZnS), galena (PbS), and chalcopyrite ($CuFeS_2$). A 100% Zn end member was used for the sphalerite calculations for simplicity. The Zn content of sphalerite at Hellyer has been reported at 93.7% Zn (molar Zn/(Zn+Fe)) by McArthur (1996) and is assumed to be 100% for the purpose of this calculation of S distribution. The calculated Fe_py value (%) is also subtracted from whole-rock Fe_total (%) to produce a Fe_no py value, which is a more useful indicator for sericitic and chloritic alteration without the effects of pyrite (refer to Chapter 5).

There are only 55 samples that contain >0.5% Ba with available S data and none of these are Bass Metal samples. Therefore, this "iron in pyrite" calculation is not affected by the analytical problems with Ba in the Bass Metals samples discussed in the previous section.

Chromium Data Correction

The following formula was used to correct for the bias in the Bass Metals samples as suggested by S. Richardson in his comparison of Cr analyses by four acid ICP and fusion ICP and XRF analyses (pers. comm., 2012).

$$\text{New Cr (ppm)} = 0.0003*(\text{old Cr value})^2 + 1.5875*(\text{old Cr value})$$

Zinc Ratio Calculations

Zinc ratio was used by Huston and Large (1987) to compare the various styles of mineralisation in the MRV and also the chemistry. Only samples with both Pb and Zn above regional background (100 ppm) were considered.

$$\text{Zn Ratio} = 100*\text{Zn}/(\text{Zn} + \text{Pb})$$

Alteration Index and Chlorite-Carbonate-Pyrite Index

$$\text{Alteration Index (AI)} = \frac{100\ (MgO + K2O)}{MgO + K_2O + CaO + Na_2O}$$

$$\text{CCPI} = \frac{100\ (FeO + MgO)}{FeO + MgO + Na_2O + K_2O}$$

Short Wavelength Infrared (SWIR) Data

All samples from Bass Metals and this study have corresponding SWIR data that have been measured from a hand sample. From the regional Bass Metal SWIR database, spectral data were allocated to previous research samples and Aberfoyle samples for corresponding intervals. Some core grind intervals include more than one available set of spectral data. In those cases, the most representative set was chosen for the whole interval. The SWIR data is filtered as described in Chapter 6. Abbreviations used in the SWIR data columns are:

Classification – general alteration mineral groups (e.g., sericite, chlorite, carbonate)

TSA_S Mineral1 – most dominant infrared-active mineral as recognised by the TSG software

TSA_S Weight1 – relative fraction of mineral1

TSA_S Mineral2 – second most dominant infrared-active mineral recognised by TSG

TSA_S Weight2 – relative fraction of mineral2

TSA_S Error – measure for each Mineral1 and Mineral2 match, which is termed the Standardised Residual Sum of Squares

w2200 – wavelength at minimum near 2200 nm

hqd2200 – depth of apparent feature at w2200

width2200 – width ot wav of the trough at minimum near 2200 nm

w2250 – wavelength at minimum near 2250 nm

hqd2250 – depth of apparent feature at w2250

w2350 – wavelength at minimum near 2250 nm

hqd2350 – depth of apparent feature at w2350

width2350 – wavelength at minimum near 2250 nm

hqd1900 – depth of apparent feature at w1900 (illite crystallinity feature)

Sericite Composition – the filtered/accepted values of w2200

Sericite Abundance – the filtered/accepted values of hqd2200

Chl Fe Comp – the filtered/accepted values of w2250

Chl Fe Abundance – the filtered/accepted values of hqd2250

Chl Mg Comp – the filtered/accepted values of w23250

Chl Mg Abundance – the filtered/accepted values of hqd2250

Appendix VI – Electron Microprobe Analyses Data with Muscovite and Chlorite Formulae Calculations

A6.1 EMPA Results

EMPA were performed on 30 muscovite and 14 chlorite samples as described in Chapter 6. The following tables provide averaged muscovite and chlorite analyses. For each individual analysis, see Excel spreadsheet included electronically in Appendix VI. Average muscovite and chlorite compositions for each sample are provided in Tables A7.1 and A7.2. Detection limits and analytical precision for both minerals are summarised in Table A7.3.

Only SiO_2, TiO_2, Al_2O_3, FeO, MnO, MgO, CaO, Na_2O, K_2O, P_2O_5, Cr_2O_3, BaO, SrO, F and Cl contents were used for muscovite formula calculations using the Tindle and Webb (1990) method. Due to a software upgrade at the Central Science Laboratory for EPMS analyses, the last set of samples (9 Mount Charter samples) does not have NiO and ZnO contents analysed. In general, NiO and ZnO concentrations determined by EMPA for other samples are generally quite low and close to detection limits, ranging from 0.024-0.050% and 0.010-0.090%, respectively. These elements are measured by LA-ICPMS for all muscovite and chlorite samples.

Table A6.1 – Average muscovite compositions (%) by EMPA with muscovite formula.

Sample (#analyses)	**HL673-09 (16/18)**	**HL673-11 (12/15)**	**HL673-14 (9/10)**	**HL683-16 (10/11)**	**HL688-05 (5/15)**	
Hole ID	HL0673	HL0673	HL0673	HL0683	HL0688	
Depth (m)	169.85	191.85	222.90	233.40	168.20	
Location	Fossey	Fossey	Fossey	Fossey	Fossey	
SiO_2	48.42	50.11	48.64	50.38	49.06	
TiO_2	0.304	0.182	0.149	0.186	0.140	
Al_2O_3	33.53	31.11	32.76	31.36	31.58	
FeO	0.614	1.47	0.589	1.09	1.88	
MnO	0.023	0.029	0.026	0.036	0.035	
MgO	2.033	2.375	2.019	2.657	2.021	
CaO	0.032	0.064	0.065	0.072	0.146	
Na_2O	0.126	0.136	0.149	0.095	0.167	
K_2O	10.25	9.84	9.77	10.29	9.64	
P_2O_5	0.020	0.009	0.088	0.022	0.014	
NiO	0.021	0.030	0.029	0.020	0.015	
Cr_2O_3	0.018	0.026	0.029	0.023	0.057	
BaO	0.926	0.707	0.592	0.496	0.486	
SrO	0.012	bdl	0.017	0.011	bdl	
ZnO	0.041	0.027	0.032	0.054	0.034	
V_2O_5	0.074	0.105	0.080	0.061	0.085	
SO_3	0.032	0.037	0.078	0.104	0.019	
F	0.577	0.430	0.406	0.246	0.251	
Cl	0.008	0.016	0.015	0.006	0.020	
Total	97.06	96.71	95.53	97.21	95.65	
Muscovite Formula (apfu):						
Si	6.370	6.598	6.458	6.583	6.521	Tetrahedral cation
Al iv	1.630	1.402	1.542	1.417	1.479	
Al vi	3.570	3.427	3.586	3.414	3.469	Octahedral cations
Ti	0.030	0.018	0.015	0.019	0.014	
Cr	0.002	0.003	0.003	0.002	0.006	
Fe	0.067	0.162	0.066	0.119	0.209	
Mn	0.002	0.003	0.003	0.004	0.003	
Mg	0.398	0.465	0.400	0.518	0.400	
Ca	0.004	0.008	0.010	0.010	0.021	Interlayer cations
Na	0.033	0.036	0.039	0.023	0.044	
K	1.720	1.653	1.655	1.715	1.634	
Sr	0.001	0.000	0.002	0.001	0.000	
Ba	0.048	0.037	0.031	0.026	0.026	
OH	3.756	3.816	3.823	3.894	3.890	Anions
F	0.241	0.179	0.172	0.103	0.105	
Cl	0.002	0.004	0.005	0.002	0.005	
Mg/(Mg+Fe)	0.856	0.742	0.859	0.813	0.657	
Al-OH (nm)	2208.95	2214.64	2209.52	2214.63	2212.91	

(#analyses = the number of analyses used out of the total number of analyses performed)

Table A6.1 (continued) – Average muscovite compositions (%) by EMPA with muscovite formula.

Sample (#analyses)	HLD1017-19 (11/15)	HLD1017-18 (8/15)	FUD16-27 (8/14)	HLD1017-25 (8/15)	HLD1017-15 (11/15)	HLD1017-08 (10/14)
Hole ID	HLD1017	HLD1017	FUD0016	HLD1017	HLD1017	HLD1017
Depth (m)	287.20	279.09	153.55	312.55	244.41	214.35
Location	Fossey East	Fossey East	Fossey East	Fossey East	Fossey East	Fossey East
SiO_2	49.92	50.65	49.93	48.37	49.85	49.03
TiO_2	0.190	0.120	0.170	0.120	0.180	0.110
Al_2O_3	30.48	31.19	33.32	30.57	33.54	30.80
FeO	0.770	1.14	0.630	1.61	0.680	1.92
MnO	0.020	0.030	0.030	0.090	0.020	0.060
MgO	2.91	2.42	2.15	4.79	1.84	3.41
CaO	0.090	0.180	0.110	0.040	0.090	0.050
Na_2O	0.120	0.080	0.110	0.080	0.070	0.070
K_2O	10.04	9.10	9.59	8.75	9.90	9.28
P_2O_5	0.020	0.010	0.010	0.010	0.030	0.020
NiO	0.030	0.030	0.030	0.030	0.030	0.030
Cr_2O_3	0.020	0.020	0.020	0.030	0.020	0.010
BaO	0.810	0.500	0.210	0.460	0.190	0.290
SrO	0.010	0.030	0.020	0.030	0.020	0.030
ZnO	0.060	0.040	0.040	0.080	0.070	0.090
V_2O_5	0.070	0.070	0.060	0.060	0.060	0.040
SO_3	0.040	0.030	0.020	0.020	0.030	0.060
F	0.480	0.260	0.410	0.480	0.320	0.420
Cl	0.030	0.040	0.020	0.040	0.030	0.040
Total	96.11	95.95	96.92	95.66	96.95	95.75
Muscovite Formula (apfu):						
Si	6.617	6.652	6.490	6.431	6.482	6.513
Al iv	1.383	1.348	1.510	1.569	1.518	1.487
Al vi	3.379	3.480	3.596	3.222	3.623	3.336
Ti	0.019	0.012	0.017	0.012	0.018	0.011
Cr	0.002	0.002	0.002	0.003	0.002	0.001
Fe	0.085	0.125	0.068	0.179	0.074	0.213
Mn	0.002	0.003	0.003	0.010	0.002	0.007
Mg	0.575	0.474	0.417	0.949	0.357	0.675
Ca	0.013	0.025	0.015	0.006	0.013	0.007
Na	0.031	0.020	0.028	0.021	0.018	0.018
K	1.697	1.524	1.590	1.484	1.642	1.572
Sr	0.001	0.002	0.002	0.002	0.002	0.002
Ba	0.042	0.026	0.011	0.024	0.010	0.015
OH	3.792	3.883	3.827	3.789	3.862	3.815
F	0.201	0.108	0.169	0.202	0.132	0.176
Cl	0.007	0.009	0.004	0.009	0.007	0.009
Mg/(Mg+Fe)	0.871	0.791	0.859	0.841	0.828	0.760
Al-OH (nm)	2217.34	2215.59	2208	2213.92	2206.92	2213.8

Table A6.1 (continued) – Average muscovite compositions (%) by EMPA with muscovite formula.

Sample (#analyses)	FUD16-09 (6/11)	HL589-14 (8/10)	HL589_17 (7/7)	365045 (15/15)	365024 (15/16)	365036 (15/17)
Hole ID	FUD0016	HL0589	HL0589	MCD35	MCD27	MCD26
Depth (m)	60.76	203.25	233.29	61.00	56.45	77.40
Location	Fossey East	Fossey Regional	Fossey Regional	Mount Charter	Mount Charter	Mount Charter
SiO_2	49.59	49.28	49.05	51.74	49.85	48.24
TiO_2	0.140	0.090	0.125	0.144	0.220	0.310
Al_2O_3	30.43	32.40	32.20	31.31	30.60	33.37
FeO	2.08	1.87	1.86	0.745	1.07	0.513
MnO	0.020	0.027	0.005	0.064	0.022	0.021
MgO	2.60	1.79	1.73	2.80	3.00	2.06
CaO	0.140	0.044	0.097	0.115	0.028	0.030
Na_2O	0.080	0.136	0.141	0.075	0.077	0.088
K_2O	9.80	9.96	10.06	9.68	10.18	10.52
P_2O_5	0.010	0.013	0.011	bdl	0.071	0.007
NiO	0.010	0.018	0.013	n/a	0.037	0.029
Cr_2O_3	0.030	0.010	bdl	0.069	0.033	0.028
BaO	0.290	0.284	0.153	0.283	0.619	0.429
SrO	0.020	0.015	0.010	bdl	0.018	0.020
ZnO	0.060	0.047	0.072	n/a	0.054	0.053
V_2O_5	0.150	0.124	0.074	0.376	0.060	0.112
SO_3	0.040	0.017	0.015	n/a	0.049	0.085
F	0.170	0.219	0.143	0.571	0.541	0.423
Cl	0.040	0.007	0.017	0.025	0.012	0.008
Total	95.70	96.35	95.77	97.99	96.52	96.35
Muscovite Formula (apfu):						
Si	6.594	6.496	6.497	6.677	6.591	6.373
Al iv	1.406	1.504	1.503	1.323	1.409	1.627
Al vi	3.362	3.530	3.524	3.441	3.360	3.571
Ti	0.014	0.009	0.013	0.014	0.022	0.031
Cr	0.003	0.001	0.000	0.007	0.003	0.003
Fe	0.231	0.206	0.206	0.080	0.118	0.057
Mn	0.002	0.003	0.001	0.007	0.002	0.002
Mg	0.515	0.352	0.342	0.539	0.590	0.406
Ca	0.020	0.006	0.014	0.016	0.004	0.004
Na	0.021	0.036	0.036	0.019	0.020	0.023
K	1.662	1.675	1.700	1.593	1.716	1.774
Sr	0.002	0.001	0.001	0.000	0.001	0.002
Ba	0.015	0.014	0.008	0.014	0.032	0.022
OH	3.919	3.906	3.937	3.761	3.771	3.821
F	0.071	0.092	0.059	0.233	0.226	0.177
Cl	0.009	0.002	0.004	0.005	0.003	0.002
Mg/(Mg+Fe)	0.690	0.630	0.624	0.870	0.834	0.878
Al-OH (nm)	2215.53	2211.48	2213.62	2214.04	2217.47	2209.01

Table A6.1 (continued) – Average muscovite compositions (%) by EMPA with muscovite formula.

Sample (#analyses)	365026 (3/15)	365047 (14/16)	361510 (13/15)	365056 (14/15)	MCD35-07 (13/15)	MCD35-13 (7/12)
Hole ID	MCD27	MCD35	MAC26	MCD35	MCD35	MCD35
Depth (m)	74.35	90.00	158.40	217.80	266.60	328.93
Location	Mount Charter	Mount Charter	Mount Charter	Mount Charter	Mount Charter	Mount Charter
SiO_2	51.04	49.02	50.64	49.86	48.99	49.30
TiO_2	0.330	0.368	0.127	0.177	0.197	0.130
Al_2O_3	32.53	32.94	32.23	34.34	32.04	32.23
FeO	1.80	0.724	1.57	0.79	2.77	3.47
MnO	0.050	0.058	0.062	0.054	0.058	0.040
MgO	2.32	2.44	2.12	1.67	1.43	1.00
CaO	0.350	0.041	0.038	0.075	0.138	0.090
Na_2O	0.100	0.061	0.068	0.087	0.314	0.090
K_2O	9.44	10.98	9.61	9.90	10.34	10.00
P_2O_5	0.490	0.037	0.055	0.054	0.042	0.020
NiO	n/a	n/a	n/a	n/a	n/a	0.050
Cr_2O_3	0.020	0.056	bdl	0.072	0.055	0.040
BaO	0.510	0.394	0.175	0.294	0.212	0.110
SrO	bdl	bdl	bdl	bdl	bdl	0.020
ZnO	n/a	n/a	n/a	n/a	n/a	0.070
V_2O_5	bdl	bdl	0.429	bdl	bdl	0.050
SO_3	n/a	n/a	n/a	n/a	n/a	0.020
F	0.310	0.595	0.223	0.388	0.157	0.120
Cl	0.020	0.025	0.033	0.024	0.023	0.030
Total	99.31	97.75	97.39	97.79	96.76	96.90
Muscovite Formula (apfu):						
Si	6.535	6.402	6.581	6.431	6.469	6.500
Al iv	1.465	1.598	1.419	1.569	1.531	1.500
Al vi	3.445	3.472	3.518	3.651	3.456	3.508
Ti	0.032	0.036	0.012	0.017	0.020	0.013
Cr	0.002	0.006	0.000	0.007	0.006	0.004
Fe	0.193	0.079	0.171	0.085	0.305	0.383
Mn	0.005	0.006	0.007	0.006	0.007	0.004
Mg	0.443	0.476	0.411	0.322	0.281	0.197
Ca	0.048	0.006	0.005	0.010	0.020	0.013
Na	0.025	0.015	0.017	0.022	0.080	0.023
K	1.542	1.829	1.593	1.629	1.741	1.682
Sr	0.000	0.000	0.000	0.000	0.000	0.002
Ba	0.026	0.020	0.009	0.015	0.011	0.006
OH	3.870	3.749	3.901	3.836	3.929	3.943
F	0.126	0.246	0.092	0.158	0.065	0.050
Cl	0.004	0.006	0.007	0.005	0.005	0.007
Mg/(Mg+Fe)	0.697	0.857	0.706	0.791	0.479	0.339
Al-OH (nm)	2211.36	2212.75	2218.3	2207.14	2210.85	2210.98

Table A6.1 (continued) – Average muscovite compositions (%) by EMPA with muscovite formula.

Sample (#analyses)	MCD35-16 (12/16)	364712 (9/10)	364719 (6/16)	361020 (7/9)	361029 (7/7)	361033 (2/12)
Hole ID	MCD35	MAC26	MAC26	MAC17	MAC17	MAC17
Depth (m)	357.93	472.00	584.25	152.80	249.90	314.95
Location	Mount Charter	Mount Charter	Mount Charter	QHV Regional	QHV Regional	QHV Regional
SiO_2	48.19	48.25	47.20	49.24	49.51	47.75
TiO_2	0.237	0.095	0.151	0.160	0.170	0.192
Al_2O_3	29.97	34.07	34.30	34.13	30.82	30.90
FeO	4.81	1.88	2.54	1.32	3.19	4.65
MnO	0.053	bdl	0.030	0.030	0.010	bdl
MgO	1.56	1.29	1.34	1.57	2.13	2.45
CaO	0.108	0.039	0.137	0.090	0.210	0.157
Na_2O	0.080	0.203	0.284	0.290	0.110	0.095
K_2O	10.48	10.11	9.84	9.81	9.70	9.93
P_2O_5	bdl	0.028	bdl	0.010	0.020	0.007
NiO	n/a	n/a	n/a	0.020	0.020	0.000
Cr_2O_3	bdl	bdl	0.020	0.030	0.009	0.031
BaO	0.296	0.293	0.313	0.410	0.200	0.304
SrO	bdl	0.060	0.026	0.020	0.002	bdl
ZnO	n/a	n/a	n/a	0.050	0.010	0.084
V_2O_5	bdl	bdl	0.194	0.090	0.090	0.155
SO_3	n/a	n/a	n/a	0.020	0.020	0.090
F	0.219	0.202	0.169	0.230	0.160	0.171
Cl	0.022	0.027	0.012	0.010	0.010	0.001
Total	96.02	96.55	96.55	97.52	96.40	96.96
Muscovite Formula (apfu):						
Si	6.500	6.348	6.245	6.396	6.553	6.378
Al iv	1.500	1.652	1.755	1.604	1.447	1.622
Al vi	3.265	3.632	3.594	3.621	3.361	3.242
Ti	0.024	0.009	0.015	0.016	0.017	0.019
Cr	0.000	0.000	0.002	0.003	0.001	0.003
Fe	0.543	0.207	0.281	0.143	0.353	0.519
Mn	0.006	0.000	0.003	0.003	0.001	0.000
Mg	0.313	0.252	0.265	0.304	0.420	0.488
Ca	0.016	0.006	0.019	0.013	0.030	0.022
Na	0.021	0.052	0.073	0.073	0.028	0.025
K	1.803	1.697	1.660	1.625	1.638	1.692
Sr	0.000	0.005	0.002	0.002	0.000	0.000
Ba	0.016	0.015	0.016	0.021	0.010	0.016
OH	3.901	3.910	3.927	3.903	3.931	3.928
F	0.094	0.084	0.071	0.094	0.067	0.072
Cl	0.005	0.006	0.003	0.002	0.002	0.000
Mg/(Mg+Fe)	0.366	0.550	0.486	0.679	0.543	0.485
Al-OH (nm)	2216.49	2207.53	2205.3	2205.79	2211.97	2216.41

Table A6.1 (continued) – Average muscovite compositions (%) by EMPA with muscovite formula.

Sample (#analyses)	364863 (8/8)
Hole ID	MAC19
Depth (m)	788.85
Location	QHV Regional
SiO_2	47.26
TiO_2	0.090
Al_2O_3	36.55
FeO	1.25
MnO	0.010
MgO	1.25
CaO	0.040
Na_2O	1.15
K_2O	8.32
P_2O_5	0.040
NiO	0.020
Cr_2O_3	0.110
BaO	0.270
SrO	0.020
ZnO	0.040
V_2O_5	0.070
SO_3	0.170
F	0.150
Cl	0.010
Total	96.83
Muscovite Formula (apfu):	
Si	6.156
Al iv	1.844
Al vi	3.767
Ti	0.009
Cr	0.011
Fe	0.136
Mn	0.001
Mg	0.243
Ca	0.006
Na	0.290
K	1.382
Sr	0.002
Ba	0.014
OH	3.936
F	0.062
Cl	0.002
Mg/(Mg+Fe)	0.641
Al-OH (nm)	2195.75

Table A6.2 – Average chlorite compositions (%) by EMPA with chlorite formula.

Sample (#analyses)	FUD17-14 (15/15)	FUD16-09 (6/13)	HL688-09 (7/7)	HL589-14 (8/12)	HL589-17 (5/6)	
Hole ID	FUD0017	FUD0016	HL0688	HL0589	HL0589	
Depth (m)	143.07	60.76	210.64	203.25	233.29	
Location	Fossey East	Fossey East	Fossey Footwall	Fossey Regional	Fossey Regional	
SiO_2	29.12	28.35	28.40	27.16	27.44	
TiO_2	0.027	0.035	0.028	0.048	0.020	
Al_2O_3	21.89	19.54	18.88	19.40	19.85	
FeO	11.49	21.16	21.94	25.13	25.58	
MnO	0.564	0.294	0.685	0.237	0.189	
MgO	24.69	18.61	18.98	15.78	15.48	
CaO	0.094	0.052	0.097	0.052	0.068	
Na_2O	0.012	0.012	0.021	0.038	0.039	
K_2O	0.013	0.170	0.023	0.024	0.125	
P_2O_5	0.080	bdl	0.018	0.016	0.013	
NiO	0.016	0.017	0.022	0.058	0.025	
Cr_2O_3	0.029	0.020	0.064	0.181	0.045	
BaO	0.052	0.065	0.050	0.135	0.061	
SrO	0.020	0.013	0.023	0.022	0.014	
ZnO	0.127	0.079	0.115	0.073	0.082	
V_2O_5	0.038	0.090	0.077	0.040	0.034	
SO_3	0.058	0.025	0.022	0.015	0.024	
F	0.551	0.192	0.135	0.220	0.152	
Cl	0.032	0.038	0.025	0.008	0.006	
Total	88.90	88.78	89.59	88.64	89.25	
FeO+MgO	36.18	39.78	40.91	40.91	41.06	
Chlorite Formula (apfu):						
Si	5.661	5.786	5.776	5.686	5.696	Tetrahedral cations
Al iv	2.339	2.214	2.224	2.314	2.304	
Al vi	2.678	2.488	2.304	2.474	2.554	Octahedral cations
Cr	0.005	0.003	0.010	0.030	0.007	
Fe	1.869	3.612	3.732	4.399	4.442	
Mn	0.093	0.051	0.118	0.042	0.033	
Mg	7.153	5.661	5.753	4.922	4.789	
Ca	0.020	0.011	0.021	0.012	0.015	
Na	0.005	0.005	0.008	0.015	0.016	
K	0.003	0.044	0.006	0.006	0.033	
Mg/(Mg+Fe)	0.793	0.610	0.607	0.528	0.519	
Fe-OH (nm)	2248.96	2248.78	2254.05	2252.37	2250.65	
Mg-OH (nm)	2335.10	2340.95	2340.02	2348.19	2345.95	

(#analyses = the number of analyses used out of the total number of analyses performed)

Table A6.2 (continued) – Average chlorite compositions (%) by EMPA with chlorite formula.

Sample (#analyses)	365026 (12/21)	MCD35-16 (5/9)	364719 (6/14)	361029 (3/6)	361033 (6/10)	361038 (10/10)
Hole ID	MCD27	MCD35	MAC26	MAC17	MAC17	MAC17
Depth (m)	74.35	357.93	584.25	249.90	314.95	379.65
Location	Mount Charter	Mount Charter	Mount Charter	QHV Regional	QHV Regional	QHV Regional
SiO_2	28.04	25.02	26.81	26.15	26.86	26.97
TiO_2	0.012	0.054	0.024	0.042	0.042	0.023
Al_2O_3	21.55	19.00	22.43	21.85	19.78	20.96
FeO	19.77	36.09	23.47	28.44	29.78	24.15
MnO	0.393	0.296	0.294	0.175	0.168	0.166
MgO	18.95	7.98	14.96	11.99	12.36	16.29
CaO	0.059	0.227	0.128	0.092	0.091	0.057
Na_2O	bdl	bdl	0.029	0.034	0.010	0.014
K_2O	0.113	0.031	0.225	0.237	0.031	0.081
P_2O_5	bdl	bdl	0.009	0.008	0.003	0.023
NiO	n/a	n/a	n/a	0.023	0.028	0.036
Cr_2O_3	bdl	bdl	0.023	0.005	0.024	0.038
BaO	bdl	0.098	0.037	0.071	0.057	0.031
SrO	bdl	bdl	0.0002	bdl	0.020	0.033
ZnO	n/a	n/a	n/a	0.055	0.086	0.063
V_2O_5	0.321	bdl	0.069	0.051	0.056	0.114
SO_3	n/a	n/a	n/a	0.025	0.027	0.025
F	0.280	0.113	0.183	0.089	0.123	0.150
Cl	0.019	0.023	0.019	0.020	0.008	0.013
Total	89.56	88.99	88.71	89.36	89.55	89.24
FeO+MgO	38.72	44.06	38.43	40.43	42.13	40.44
Chlorite Formula (apfu):						
Si	5.627	5.542	5.526	5.502	5.682	5.560
Al iv	2.373	2.458	2.474	2.498	2.318	2.440
Al vi	2.725	2.505	2.977	2.921	2.614	2.654
Cr	0.010	0.012	0.004	0.001	0.004	0.006
Fe	3.318	6.686	4.047	5.003	5.266	4.162
Mn	0.067	0.056	0.051	0.031	0.030	0.029
Mg	5.669	2.634	4.597	3.759	3.895	5.006
Ca	0.013	0.054	0.028	0.021	0.021	0.013
Na	n/a	n/a	0.012	0.014	0.004	0.006
K	0.029	0.009	0.059	0.064	0.008	0.021
Mg/(Mg+Fe)	0.631	0.283	0.532	0.429	0.425	0.546
Fe-OH (nm)	2248.47	2250.91	2247.34	2250.96	2252.29	2252.87
Mg-OH (nm)	2346.82	2355.84	2346.16	2347.92	2347.53	2342.31

Table A6.2 (continued) – Average chlorite compositions (%) by EMPA with chlorite formula.

Sample (#analyses)	361042 (9/10)	364870 (6/9)	364875 (7/9)
Hole ID	MAC17	MAC19	MAC19
Depth (m)	436.65	854.8	915.75
Location	QHV Regional	QHV Regional	QHV Regional
SiO_2	26.3	24.8	24.9
TiO_2	0.025	0.023	0.037
Al_2O_3	20.3	22.9	20.2
FeO	27.4	29.8	32.7
MnO	0.459	0.078	0.468
MgO	14.1	11.2	10.3
CaO	0.089	0.042	0.070
Na_2O	0.021	0.027	0.079
K_2O	0.013	0.124	0.056
P_2O_5	0.010	0.015	0.013
NiO	0.037	0.056	0.015
Cr_2O_3	0.034	0.036	0.011
BaO	0.124	0.016	0.109
SrO	0.013	0.046	0.006
ZnO	0.090	0.101	0.188
V_2O_5	0.070	0.073	0.027
SO_3	0.016	0.040	0.022
F	0.076	0.088	0.088
Cl	0.012	0.022	0.013
Total	89.3	89.5	89.4
FeO+MgO	41.5	41.1	43.0
Chlorite Formula (apfu):			
Si	5.540	5.253	5.412
Al iv	2.460	2.747	2.588
Al vi	2.572	2.978	2.590
Cr	0.006	0.006	0.002
Fe	4.824	5.292	5.927
Mn	0.082	0.014	0.086
Mg	4.425	3.551	3.340
Ca	0.020	0.010	0.016
Na	0.009	0.011	0.033
K	0.004	0.033	0.015
Mg/(Mg+Fe)	0.631	0.283	0.532
Fe-OH (nm)	2248.47	2250.91	2247.34
Mg-OH (nm)	2346.82	2355.84	2346.16

Table A6.3 – Detection limits and standard deviation of EMPA analyses.

	Detection limit (wt%)		**Standard Deviation (wt%)**	
	Max	Min	Max	Min
Na	0.034	0.071	0.037	0.191
Si	0.032	0.050	0.030	0.688
Al	0.022	0.032	0.020	0.527
Mg	0.021	0.032	0.020	0.265
Cl	0.021	0.043	0.017	0.036
K	0.028	0.045	0.027	0.291
Ca	0.026	0.046	0.025	0.650
Cr	0.048	0.090	0.045	0.107
Mn	0.044	0.078	0.040	0.137
Fe	0.064	0.097	0.068	0.686
Ti	0.039	0.068	0.034	0.187
Ni	0.082	0.124	0.071	0.103
S	0.015	0.025	0.013	0.065
P	0.019	0.039	0.019	0.160
Sr	0.062	0.102	0.053	0.082
Ba	0.238	0.293	0.211	0.438
F	0.089	0.123	0.040	0.142
Zn	0.139	0.177	0.123	0.159
V	0.041	0.249	0.034	0.205

Appendix VII – Laser Ablation IC-PMS Data for Muscovite, Chlorite and K-Feldspar

A7.1 LA-ICPMS Results

Averaged mineral compositions presented in Chapter 6 are summarised in the following tables (Tables A7.1-A7.3). For each individual analysis, see Excel spreadsheet included electronically in Appendix VII. Detection limits and analytical precision for each mineral type are summarised in Table A7.4.

Table A7.1 – Average muscovite compositions by LA-ICPMS.

Sample (#analyses)		HL673-09 (8/19)	HL673_11 (12/21)	HL673-14 (10/15)	HL683-16 (11/17)	HL688-05 (4/18)	HLD1017-19 (12/18)
Hole ID		HL0673	HL0673	HL0673	HL0683	HL0688	HLD1017
Depth		169.85	191.85	222.89	233.40	168.19	279.09
Location		Fossey	Fossey	Fossey	Fossey	Fossey	Fossey East
SiO_2	(%)	53.29	52.99	51.56	54.09	55.60	55.46
TiO_2	(%)	0.327	0.337	0.166	0.380	0.822	0.268
Al_2O_3	(%)	33.53	31.27	32.76	31.40	31.58	30.48
FeO	(%)	0.85	1.79	0.67	0.98	3.76	0.78
MgO	(%)	2.16	2.66	2.02	2.70	3.00	3.01
CaO	(%)	0.087	0.105	0.034	0.193	0.275	0.157
Na_2O	(%)	0.104	0.082	0.145	0.083	1.172	0.368
K_2O	(%)	11.56	11.09	10.58	10.46	9.15	11.20
BaO	(%)	1.146	1.031	0.920	0.520	0.926	1.205
Li7	(ppm)	17.0	18.8	12.8	13.2	19.4	19.2
B11	(ppm)	91.4	47.9	65.8	46.3	96.7	40.0
Ca43	(ppm)	1203	773	446	1370	2098	1125
V51	(ppm)	397	449	414	373	522	439
Cr53	(ppm)	112	102	59	203	281	58
Co59	(ppm)	7.7	3.4	1.9	10.2	18.0	0.9
Ni60	(ppm)	4.8	1.8	1.8	2.2	10.1	<bdl
Cu63	(ppm)	8.5	4.4	5.0	6.5	7.0	2.3
Cu65	(ppm)	10.2	4.3	5.3	6.3	6.9	2.7
Zn66	(ppm)	130.3	57.5	33.0	28.6	98.9	33.9
Zn68	(ppm)	157.6	78.7	51.9	45.2	121.4	56.5
As75	(ppm)	19.9	6.7	22.2	16.0	8.5	11.0
Rb85	(ppm)	351	395	322	422	294	393
Sr88	(ppm)	10.6	10.2	14.6	12.3	76.9	17.8
Y89	(ppm)	21.2	3.9	7.1	7.6	17.1	9.1
Zr90	(ppm)	112	16	15	36	174	39
Ag107	(ppm)	0.20	0.14	0.10	0.10	0.14	0.14
Sn118	(ppm)	2.2	2.5	3.0	2.1	1.9	2.0
Sb121	(ppm)	31.6	16.1	4.7	20.7	23.8	14.3
Cs133	(ppm)	10.1	12.8	10.8	25.7	12.8	11.1
La139	(ppm)	15.8	2.8	16.1	16.5	1.0	26.4
Ce140	(ppm)	38.4	5.9	32.2	32.7	3.1	54.8
Tl205	(ppm)	24.9	21.2	10.0	8.9	18.1	18.3
Pb208	(ppm)	11.2	5.0	6.1	4.1	3.3	4.4
Bi209	(ppm)	<bdl	0.01	<bdl	<bdl	<bdl	0.02
U238	(ppm)	3.1	0.4	0.4	0.9	3.7	1.1
FeO+MgO	(%)	3.01	4.45	2.68	3.68	6.76	3.79
Mg/(Mg+Fe)		0.662	0.662	0.536	0.702	0.681	0.382

(#analyses = the number of analyses used out of the total number of analyses performed; bdl = below detection limit)

Table A7.1 (continued) – Average muscovite compositions by LA-ICPMS.

Sample (#analyses)		**HLD1017-18 (10/15)**	**FUD16-27 (9/15)**	**HLD1017-15 (14/16)**	**HLD1017-08 (12/17)**	**FUD16-09 (2/15)**	**HL589-14 (2/9)**
Hole ID		HLD1017	FUD0016	HLD1017	HLD1017	FUD0016	HL0589
Depth		279.09	153.55	244.41	214.35	60.76	203.25
Location		Fossey East	Fossey East	Fossey East	Fossey East	Fossey East	Fossey Regional
SiO_2	(%)	56.75	54.89	54.13	55.29	53.70	55.07
TiO_2	(%)	0.120	0.099	0.212	0.114	0.297	0.119
Al_2O_3	(%)	31.19	33.32	33.54	31.43	30.43	32.40
FeO	(%)	1.23	0.84	0.73	1.32	2.44	2.60
MgO	(%)	2.52	2.55	1.98	2.71	2.86	2.09
CaO	(%)	0.223	0.215	0.106	0.132	0.206	0.151
Na_2O	(%)	0.170	0.107	0.079	0.080	0.251	0.112
K_2O	(%)	10.32	10.80	11.34	10.84	10.27	11.11
BaO	(%)	0.564	0.297	0.372	0.417	0.380	0.247
Li7	(ppm)	15.0	9.9	10.5	14.2	10.2	7.8
B11	(ppm)	44.1	45.1	50.1	46.9	52.4	70.7
Ca43	(ppm)	1667	1641	827	964	1669	1386
V51	(ppm)	351	366	363	328	717	923
Cr53	(ppm)	18	120	64	37	102	30
Co59	(ppm)	0.3	0.7	0.4	2.8	7.6	2.1
Ni60	(ppm)	1.0	1.4	1.0	2.6	16.3	5.2
Cu63	(ppm)	1.5	4.7	4.0	1.9	5.6	1.2
Cu65	(ppm)	1.7	4.5	3.9	2.0	5.2	1.1
Zn66	(ppm)	22.3	24.3	75.4	35.5	42.3	42.2
Zn68	(ppm)	33.3	31.8	79.4	43.0	47.0	47.5
As75	(ppm)	9.5	3.7	4.1	7.7	10.1	2.4
Rb85	(ppm)	332	388	422	346	324	395
Sr88	(ppm)	66.8	20.8	13.5	9.3	25.1	7.0
Y89	(ppm)	2.6	8.6	4.7	3.4	4.8	0.8
Zr90	(ppm)	4	57	23	18	45	10
Ag107	(ppm)	0.11	<bdl	<bdl	<bdl	<bdl	<bdl
Sn118	(ppm)	2.5	2.1	1.9	1.5	2.2	13.2
Sb121	(ppm)	21.9	4.6	2.8	8.7	14.9	2.7
Cs133	(ppm)	38.7	21.0	14.2	22.3	14.9	14.4
La139	(ppm)	0.2	6.1	0.2	2.2	14.6	0.2
Ce140	(ppm)	0.4	12.9	0.5	4.7	29.7	0.4
Tl205	(ppm)	10.4	5.6	5.8	7.2	4.5	3.9
Pb208	(ppm)	1.0	7.1	0.8	6.4	1.2	1.4
Bi209	(ppm)	<bdl	0.12	0.02	<bdl	<bdl	<bdl
U238	(ppm)	0.3	1.4	0.5	0.4	1.1	0.2
FeO+MgO	(%)	3.75	3.39	2.71	4.03	5.30	4.69
Mg/(Mg+Fe)		0.662	0.612	0.701	0.678	0.615	0.476

(#analyses = the number of analyses used out of the total number of analyses performed; bdl = below detection limit)

Table A7.1 (continued) – Average muscovite compositions by LA-ICPMS.

Sample (#analyses)		**HL589-17 (8/14)**	**365045 (11/15)**	**365024 (12/15)**	**365036 (8/10)**	**365026 (7/14)**	**365047 (11/17)**
Hole ID		HL0589	MCD35	MCD27	MCD26	MCD27	MCD35
Depth		233.29	61.00	56.45	77.40	74.35	90.00
Location		Fossey Regional	Mount Charter	Mount Charter	Mount Charter	Mount Charter	Mount Charter
SiO_2	(%)	57.54	56.94	51.89	55.50	58.65	57.29
TiO_2	(%)	0.109	0.155	0.247	0.196	0.824	0.351
Al_2O_3	(%)	32.20	31.31	30.60	33.37	32.53	32.94
FeO	(%)	1.91	0.74	1.13	0.50	4.03	0.69
MgO	(%)	2.00	2.88	3.06	2.32	3.63	2.59
CaO	(%)	0.266	0.135	0.195	0.067	0.772	0.041
Na_2O	(%)	0.131	0.061	0.079	0.110	0.232	0.068
K_2O	(%)	10.70	11.42	11.52	11.36	10.83	12.52
BaO	(%)	0.227	0.479	0.994	0.452	0.990	0.719
Li7	(ppm)	8.0	14.3	30.3	12.0	22.8	26.1
B11	(ppm)	78.1	48.3	33.7	66.5	54.6	50.1
Ca43	(ppm)	1847	1063	1546	483	5359	565
V51	(ppm)	726	1463	381	650	402	451
Cr53	(ppm)	64	16	7	15	6	4
Co59	(ppm)	1.4	1.1	0.5	2.8	6.2	0.6
Ni60	(ppm)	3.1	1.7	0.6	0.7	2.1	0.7
Cu63	(ppm)	2.1	9.1	2.5	2.8	2.9	1.2
Cu65	(ppm)	2.3	9.1	2.5	2.0	2.9	1.7
Zn66	(ppm)	20.8	1023.4	248.2	220.3	550.5	83.8
Zn68	(ppm)	27.0	1032.7	261.2	226.1	568.6	91.4
As75	(ppm)	2.0	12.5	15.0	13.5	25.1	15.6
Rb85	(ppm)	340	412	416	366	343	404
Sr88	(ppm)	16.1	5.7	7.3	6.3	20.2	5.8
Y89	(ppm)	1.5	1.8	10.9	5.5	31.1	2.5
Zr90	(ppm)	4	12	60	20	152	37
Ag107	(ppm)	<bdl	0.46	0.12	0.46	0.52	0.30
Sn118	(ppm)	3.0	5.2	2.9	3.6	3.4	2.4
Sb121	(ppm)	5.4	22.0	17.6	43.7	36.5	8.2
Cs133	(ppm)	14.4	19.5	10.5	13.0	17.1	5.2
La139	(ppm)	0.1	3.9	43.9	22.0	169.5	3.9
Ce140	(ppm)	0.2	7.1	83.6	39.2	327.7	7.0
Tl205	(ppm)	3.7	19.6	21.9	18.5	29.2	20.1
Pb208	(ppm)	1.8	168.3	7.4	44.0	10.4	2.2
Bi209	(ppm)	<bdl	0.05	0.03	0.02	0.08	<bdl
U238	(ppm)	0.3	0.2	2.0	0.4	7.0	1.0
FeO+MgO	(%)	3.92	3.62	4.19	2.82	7.65	3.28
Mg/(Mg+Fe)		0.662	0.448	0.751	0.677	0.784	0.411

(#analyses = the number of analyses used out of the total number of analyses performed; bdl = below detection limit)

Table A7.1 (continued) – Average muscovite compositions by LA-ICPMS.

Sample (#analyses)		361510 (8/15)	365056 (14/16)	MCD35-07 (6/15)	MCD35-13 (2/15)	364712 (12/15)	364719 (5/18)
Hole ID		MAC26	MCD35	MCD35	MCD35	MAC26	MCD35
Depth		158.40	217.80	266.60	328.93	472.00	584.25
Location		Mount Charter	Mount Charter	Mount Charter	Mount Charter	Mount Charter	Mount Charter
SiO_2	(%)	57.40	55.74	58.05	57.62	53.63	52.01
TiO_2	(%)	0.177	0.227	0.228	0.104	0.104	0.175
Al_2O_3	(%)	32.23	34.34	32.04	32.23	34.07	33.98
FeO	(%)	1.95	0.85	4.82	3.92	2.10	5.28
MgO	(%)	2.54	1.76	1.73	0.88	1.44	3.07
CaO	(%)	0.102	0.118	0.182	0.128	0.038	0.170
Na_2O	(%)	0.070	0.092	1.038	0.491	0.233	0.522
K_2O	(%)	11.39	11.61	10.79	12.17	11.41	9.58
BaO	(%)	0.334	0.502	0.292	0.307	0.472	0.472
Li7	(ppm)	27.1	11.7	12.4	8.7	4.3	17.9
B11	(ppm)	55.0	69.7	72.2	73.7	65.9	45.5
Ca43	(ppm)	1024	883	1245	778	475	1233
V51	(ppm)	353	455	33	75	436	505
Cr53	(ppm)	8	12	<bdl	7	13	8
Co59	(ppm)	3.9	2.9	0.6	0.3	1.3	1.1
Ni60	(ppm)	2.5	1.0	1.5	0.6	2.4	2.4
Cu63	(ppm)	7.4	8.1	3.3	<bdl	3.9	4.9
Cu65	(ppm)	7.4	8.1	3.4	<bdl	4.2	5.4
Zn66	(ppm)	256.5	79.9	67.1	47.7	20.6	72.2
Zn68	(ppm)	254.6	80.3	73.6	57.9	26.0	77.2
As75	(ppm)	21.6	14.8	2.4	1.5	2.4	3.5
Rb85	(ppm)	359	323	338	363	367	342
Sr88	(ppm)	8.6	7.1	22.0	32.8	9.2	16.6
Y89	(ppm)	9.8	18.2	12.7	20.8	1.3	56.6
Zr90	(ppm)	40	167	83	168	29	546
Ag107	(ppm)	0.22	<bdl	<bdl	<bdl	0.22	<bdl
Sn118	(ppm)	1.1	2.3	3.7	13.7	1.2	2.0
Sb121	(ppm)	10.6	7.7	5.6	3.8	4.6	2.6
Cs133	(ppm)	18.9	16.2	14.3	18.3	14.5	10.4
La139	(ppm)	2.7	2.4	28.9	0.9	0.1	6.2
Ce140	(ppm)	7.9	5.5	56.7	2.7	0.4	14.0
Tl205	(ppm)	9.1	6.4	3.7	2.8	3.6	2.6
Pb208	(ppm)	4.2	9.2	1.2	1.4	1.6	3.2
Bi209	(ppm)	0.05	0.07	<bdl	0.02	0.04	0.19
U238	(ppm)	1.1	5.1	2.1	5.2	0.6	17.8
FeO+MgO	(%)	4.50	2.62	6.54	4.79	3.54	8.36
Mg/(Mg+Fe)		0.662	0.502	0.615	0.217	0.148	0.346

(#analyses = the number of analyses used out of the total number of analyses performed; bdl = below detection limit)

Table A7.1 (continued) – Average muscovite compositions by LA-ICPMS.

Sample (#analyses)		**361020 (6/10)**	**361029 (4/14)**	**361033 (5/8)**	**364863 (4/10)**
Hole ID		MAC17	MAC17	MAC17	MAC19
Depth		152.80	249.90	314.95	788.85
Location		Regional	Regional	Regional	Regional
SiO_2	(%)	53.40	61.35	56.52	53.27
TiO_2	(%)	0.204	0.301	0.197	0.237
Al_2O_3	(%)	34.13	30.82	30.90	36.55
FeO	(%)	1.45	4.57	6.72	1.15
MgO	(%)	1.61	2.61	3.13	1.15
CaO	(%)	0.129	0.204	0.190	0.046
Na_2O	(%)	0.323	0.312	0.212	1.127
K_2O	(%)	11.04	10.20	10.46	9.92
BaO	(%)	0.581	0.275	0.359	0.277
Li7	(ppm)	5.2	8.9	10.0	13.1
B11	(ppm)	92.3	72.3	64.6	109.0
Ca43	(ppm)	936	1255	1233	647
V51	(ppm)	457	497	890	294
Cr53	(ppm)	131	9	118	605
Co59	(ppm)	5.9	6.3	27.6	4.2
Ni60	(ppm)	3.9	8.2	29.6	12.0
Cu63	(ppm)	11.3	5.1	4.9	7.1
Cu65	(ppm)	10.4	5.1	5.7	6.9
Zn66	(ppm)	29.7	67.5	90.2	22.7
Zn68	(ppm)	44.0	72.6	98.2	30.6
As75	(ppm)	40.6	4.7	12.4	12.6
Rb85	(ppm)	354	388	416	400
Sr88	(ppm)	46.1	13.0	12.1	145.9
Y89	(ppm)	5.5	4.3	10.4	11.5
Zr90	(ppm)	22	38	83	140
Ag107	(ppm)	0.16	<bdl	0.28	0.42
Sn118	(ppm)	2.4	1.8	2.1	3.2
Sb121	(ppm)	17.7	7.0	14.9	10.1
Cs133	(ppm)	8.5	11.6	11.5	11.9
La139	(ppm)	4.0	1.8	3.4	1.0
Ce140	(ppm)	8.0	3.9	7.9	3.3
Tl205	(ppm)	5.8	4.1	4.9	1.9
Pb208	(ppm)	10.0	2.0	7.8	9.5
Bi209	(ppm)	0.14	0.09	0.21	0.30
U238	(ppm)	0.6	1.6	1.8	17.7
FeO+MgO	(%)	3.05	7.18	9.85	2.30
Mg/(Mg+Fe)		0.462	0.307	0.265	0.438

(#analyses = the number of analyses used out of the total number of analyses performed; bdl = below detection limit)

Table A7.2 – Average chlorite compositions by LA-ICPMS.

Sample (#analyses)		FUD17-14 (14/16)	FUD16-09 (1/15)	HL688-09 (13/19)	HL589-14 (9/17)	HL589-17 (1/10)	365026 (10/17)
Hole ID		FUD0017	FUD0016	HL0688	HL0589	HL0589	MCD27
Depth		143.07	60.76	210.64	203.25	233.29	74.35
Location		Fossey	Fossey	Fossey	Fossey	Fossey	Mount Charter
SiO_2	(%)	32.42	34.48	27.78	28.94	29.49	32.87
TiO_2	(%)	0.065	0.025	0.005	0.027	0.026	0.019
Al_2O_3	(%)	21.89	19.54	18.88	19.40	19.85	21.51
FeO	(%)	12.66	23.69	26.49	20.52	32.18	21.48
MgO	(%)	26.22	19.43	19.30	15.83	16.03	20.89
MnO	(%)	0.106	0.059	0.125	0.046	0.033	0.072
CaO	(%)	0.184	0.104	0.083	0.088	0.070	0.029
Na_2O	(%)	0.006	0.016	0.006	0.005	0.017	0.005
K_2O	(%)	0.018	0.473	0.003	0.005	0.231	0.024
BaO	(%)	0.003	0.021	0.001	0.003	0.013	0.003
Li7	(ppm)	203	55	82	76	59	148
B11	(ppm)	2.4	5.6	2.3	6.3	4.2	3.1
V51	(ppm)	283	494	409	345	242	230
Cr53	(ppm)	114.4	40.0	352.4	540.7	395.7	11.6
Co59	(ppm)	3.5	21.4	13.4	45.7	22.3	5.0
Ni60	(ppm)	16.8	140.6	94.0	123.2	133.0	4.3
Cu63	(ppm)	1.3	<bdl	1.9	<bdl	<bdl	2.2
Zn66	(ppm)	1696	938	1108	753	421	1544
As75	(ppm)	19.02	8.37	1.67	2.29	2.84	40.18
Sr88	(ppm)	10.24	7.83	4.28	5.67	8.65	2.07
Y89	(ppm)	17.35	1.62	0.29	4.32	4.93	3.91
Zr90	(ppm)	95.81	1.79	2.03	4.28	0.93	5.11
Ag107	(ppm)	<bdl	<bdl	<bdl	<bdl	<bdl	<bdl
Sn118	(ppm)	1.77	0.38	0.30	0.87	0.19	1.49
Sb121	(ppm)	0.87	2.10	0.23	0.34	0.64	9.11
Cs133	(ppm)	9.12	14.13	0.27	4.09	8.92	8.64
La139	(ppm)	1.67	0.04	0.09	0.19	0.17	0.30
Ce140	(ppm)	4.57	0.19	0.22	0.50	0.47	1.04
Tl205	(ppm)	0.15	0.38	0.04	0.06	0.16	3.91
Pb208	(ppm)	10.80	0.29	0.51	2.49	0.43	1.08
Bi209	(ppm)	0.51	<bdl	<bdl	<bdl	<bdl	0.04
U238	(ppm)	2.57	0.06	0.04	0.12	0.12	0.20
FeO+MgO	(%)	38.88	43.12	45.79	36.35	48.21	42.37
Mg/(Mg+Fe)		0.662	0.616	0.389	0.361	0.374	0.279

(#analyses = the number of analyses used out of the total number of analyses performed; bdl = below detection limit)

Table A7.2 (continued) – Average chlorite compositions by LA-ICPMS.

Sample (#analyses)		**MCD35-16 (3/12)**	**364719 (8/18)**	**361029 (1/8)**	**361033 (7/8)**	**361038 (10/13)**	**361042 (9/12)**
Hole ID		MCD35	MAC26	MAC17	MAC17	MAC17	MAC17
Depth		357.93	584.25	249.90	314.95	379.65	436.65
Location		Mount Charter	Mount Charter	Regional	Regional	Regional	Regional
SiO_2	(%)	26.89	27.01	30.95	28.42	28.87	27.70
TiO_2	(%)	0.059	0.023	0.023	0.032	0.020	0.020
Al_2O_3	(%)	19.31	22.43	21.85	19.78	20.96	20.29
FeO	(%)	37.71	25.80	31.83	31.44	26.33	29.34
MgO	(%)	7.66	15.68	12.93	13.25	17.30	14.75
MnO	(%)	0.049	0.058	0.036	0.033	0.032	0.085
CaO	(%)	0.077	0.075	0.081	0.094	0.054	0.077
Na_2O	(%)	0.029	0.020	<bdl	0.018	0.031	0.011
K_2O	(%)	0.419	0.143	0.032	0.019	0.005	0.052
BaO	(%)	0.020	0.005	0.003	0.005	0.002	0.011
Li7	(ppm)	41	125	64	43	56	48
B11	(ppm)	6.3	2.9	4.0	4.9	1.9	3.1
V51	(ppm)	93	305	208	345	470	348
Cr53	(ppm)	15.9	6.7	<bdl	37.6	188.8	177.4
Co59	(ppm)	39.3	6.9	34.9	32.1	19.0	53.4
Ni60	(ppm)	8.2	12.0	108.0	136.7	213.3	111.3
Cu63	(ppm)	0.6	1.1	<bdl	<bdl	0.6	0.9
Zn66	(ppm)	502	545	864	650	638	989
As75	(ppm)	2.68	2.21	3.16	3.85	1.51	2.13
Sr88	(ppm)	5.89	2.11	8.87	7.42	4.03	7.90
Y89	(ppm)	4.59	4.94	4.09	3.70	5.80	5.04
Zr90	(ppm)	1.56	2.89	5.99	1.07	41.49	1.03
Ag107	(ppm)	<bdl	<bdl	<bdl	<bdl	<bdl	<bdl
Sn118	(ppm)	0.82	0.37	0.28	0.42	0.21	0.35
Sb121	(ppm)	0.48	0.21	1.08	0.70	0.31	0.30
Cs133	(ppm)	4.44	2.17	1.41	4.47	2.38	3.17
La139	(ppm)	0.45	97.45	0.23	0.35	0.07	0.58
Ce140	(ppm)	1.28	207.09	0.62	0.99	0.29	1.69
Tl205	(ppm)	0.20	0.07	0.08	0.05	0.02	0.07
Pb208	(ppm)	0.96	0.48	0.88	0.65	0.55	0.68
Bi209	(ppm)	<bdl	<bdl	<bdl	<bdl	<bdl	0.02
U238	(ppm)	0.25	0.17	0.25	0.14	1.05	0.16
FeO+MgO	(%)	45.37	41.49	44.76	44.69	43.63	44.09
Mg/(Mg+Fe)		0.662	0.136	0.320	0.240	0.246	0.338

(#analyses = the number of analyses used out of the total number of analyses performed; bdl = below detection limit)

Table A7.2 (continued) – Average chlorite compositions by LA-ICPMS.

Sample (#analyses)		**364870 (7/9)**	**364875 (7/14)**
Hole ID		MAC19	MAC19
Depth		854.80	915.75
Location		Regional	Regional
SiO_2	(%)	25.90	29.93
TiO_2	(%)	0.022	0.034
Al_2O_3	(%)	22.90	20.25
FeO	(%)	30.34	34.27
MgO	(%)	11.79	11.80
MnO	(%)	0.014	0.089
CaO	(%)	0.053	0.035
Na_2O	(%)	0.010	0.005
K_2O	(%)	0.305	0.002
BaO	(%)	0.009	0.004
Li7	(ppm)	104	53
B11	(ppm)	3.8	1.2
V51	(ppm)	313	151
Cr53	(ppm)	266.5	14.0
Co59	(ppm)	167.5	68.3
Ni60	(ppm)	282.3	19.6
Cu63	(ppm)	0.8	<bdl
Zn66	(ppm)	840	2360
As75	(ppm)	0.44	0.49
Sr88	(ppm)	7.88	8.18
Y89	(ppm)	0.47	0.98
Zr90	(ppm)	0.44	0.52
Ag107	(ppm)	<bdl	<bdl
Sn118	(ppm)	0.18	0.11
Sb121	(ppm)	0.28	0.11
Cs133	(ppm)	0.79	0.92
La139	(ppm)	0.03	0.17
Ce140	(ppm)	0.11	0.65
Tl205	(ppm)	0.09	<bdl
Pb208	(ppm)	0.21	0.34
Bi209	(ppm)	0.02	<bdl
U238	(ppm)	<bdl	0.04
FeO+MgO	(%)	42.14	46.07
Mg/(Mg+Fe)		0.662	0.232

(#analyses = the number of analyses used out of the total number of analyses performed; bdl = below detection limit)

Table A7.3 – Average K-feldspar compositions by LA-ICPMS.

Sample (#analyses)		365045 (9/19)	365034 (15/19)	365036 (6/25)	365047 (11/17)	MCD35-13 (8/28)
Hole ID		MCD35	MCD26	MCD26	MCD35	MCD35
Depth		61.00	51.85	77.40	90.00	328.93
Location		Mount Charter	Mount Charter	Mount Charter	Mount Charter	Mount Charter
SiO_2	(%)	65.50	60.82	63.08	62.50	68.93
TiO_2	(%)	0.160	0.076	0.092	0.004	0.072
Al_2O_3	(%)	17.88	19.42	20.19	15.54	17.36
FeO	(%)	0.565	0.549	0.133	0.002	1.084
MgO	(%)	0.169	0.037	0.411	0.006	0.155
CaO	(%)	0.171	0.102	0.205	0.021	0.076
Na_2O	(%)	0.381	0.352	0.270	0.355	1.250
K_2O	(%)	13.16	14.71	14.11	18.09	10.48
BaO	(%)	2.082	4.148	1.518	3.486	0.589
%An		1.0	0.6	1.2	0.1	0.5
%Ab		4.2	3.5	2.8	2.9	15.3
%Or		94.8	96.0	96.0	97.0	84.2
Li7	(ppm)	1.6	<bdl	1.8	1.5	2.0
B11	(ppm)	4.8	4.1	12.5	3.7	8.1
Ca43	(ppm)	1709	1604	1644	<bdl	1267
V51	(ppm)	65.6	27.8	130.3	1.9	6.5
Cr53	(ppm)	<3.3	4.2	4.4	<bdl	<bdl
Co59	(ppm)	3.1	1.4	1.5	0.2	1.3
Ni60	(ppm)	1.9	0.7	<bdl	<bdl	<bdl
Cu63	(ppm)	4.7	9.1	4.0	1.6	2.6
Cu65	(ppm)	5.0	7.4	2.1	<bdl	3.7
Zn66	(ppm)	83.0	440.8	41.3	7.6	11.7
Zn68	(ppm)	103.1	410.8	61.5	45.5	18.9
As75	(ppm)	22.3	44.4	18.8	22.4	3.4
Rb85	(ppm)	240	257	259	276	177
Sr88	(ppm)	45.1	73.5	37.2	67.0	98.5
Y89	(ppm)	6.9	4.1	13.7	0.2	43.3
Zr90	(ppm)	61.6	32.3	99.5	0.7	320.9
Ag107	(ppm)	0.6	2.9	0.2	0.1	0.3
Sn118	(ppm)	0.5	0.4	0.7	0.2	1.2
Sb121	(ppm)	4.6	10.2	12.3	0.6	2.6
Cs133	(ppm)	2.2	1.0	3.0	1.1	2.4
La139	(ppm)	19.3	7.2	27.2	0.2	10.6
Ce140	(ppm)	38.8	13.4	52.4	0.3	24.7
Tl205	(ppm)	18.9	33.7	29.0	11.0	2.1
Pb208	(ppm)	744.5	86.5	11.7	6.6	2.0
Bi209	(ppm)	0.42	0.20	0.03	<bdl	0.17
U238	(ppm)	2.3	2.3	3.6	0.1	8.3

(#analyses = the number of analyses used out of the total number of analyses performed; An = anorthite; Ab = albite; Or = orthoclase; bdl = below detection limit)

Table A7.4 – Detection limits and error of LA-ICPMS analyses. Numbers provided are medians of the range of detection limits and errors.

	Muscovite		Chlorite		K-Feldspar	
	Detection Limit (ppm)	Error - 1σ (ppm)	Detection Limit (ppm)	Error - 1σ (ppm)	Detection Limit (ppm)	Error - 1σ (ppm)
Li7	0.24	0.58	0.16	1.06	1.10	0.63
B11	2.34	3.65	1.34	0.84	2.88	1.94
Na23	27	8	18	4	60	16
Mg24	0.6	20.6	0.6	49.3	2.0	3.7
Al27	1	69	1	51	4	71
Si29	447	690	274	470	389	961
K39	10	48	7	3	24	75
Ca43*	287	128	203	89	636	234
Ca44	87	34	N/A	N/A	84	36
Ti47	2	17	1	5	4	11
V51	0.15	2.67	0.12	2.20	0.42	0.76
Cr53	1.49	2.42	1.15	4.11	2.98	1.76
Mn55	N/A	N/A	0.69	5.88	N/A	N/A
Fe57	22	64	17	292	25	24
Co59	0.16	0.23	0.10	0.62	0.24	0.24
Ni60	0.61	0.52	0.56	2.59	1.19	0.45
Cu63*	0.61	0.49	0.52	0.44	1.69	0.93
Cu65	0.73	0.66	N/A	N/A	2.10	1.25
Zn66*	0.74	2.55	0.70	9.87	1.36	2.50
Zn68	3.57	3.56	N/A	N/A	2.67	4.28
As75	0.80	1.16	0.63	0.68	1.28	1.91
Rb85	0.16	2.10	N/A	N/A	0.71	2.57
Sr88	0.04	0.30	0.04	0.20	0.08	0.99
Y89	0.03	0.17	0.03	0.14	0.08	0.27
Zr90	0.07	0.62	0.07	0.16	0.15	0.98
Ag107	0.12	0.08	0.10	0.07	0.22	0.20
Sn118	0.13	0.25	0.09	0.12	0.22	0.21
Sb121	0.14	0.43	0.10	0.10	0.21	0.32
Cs133	0.04	0.29	0.03	0.13	0.17	0.15
Ba137	0.21	11.87	0.18	0.93	0.47	35.30
La139	0.02	0.08	0.02	0.04	0.05	0.30
Ce140	0.03	0.14	0.02	0.06	0.04	0.42
Tl205	0.05	0.22	0.04	0.03	0.08	0.40
Pb208	0.04	0.17	0.04	0.07	0.10	0.37
Bi209	0.02	0.02	0.02	0.02	0.04	0.06
U238	0.02	0.04	0.02	0.03	0.04	0.12

(denotes the isotope used for the element concentrations when more than one isotope is measured for an element; N/A = isotope not analysed for that mineral)*

Appendix VIII – Regional Short Wavelength Infrared Data

A8.1 Regional Short Wavelength Infrared (SWIR) Data

A total of 66,270 SWIR measurements were collected from drill hole samples across the Que Hellyer district by Bass Metals geologists. The SWIR data have been filtered using the criteria as described in Chapter 6. Some analyses were removed due to interference with the 2200 nm, 2250, and 2350 nm absorption features. A total of 59,351 measurements remain and the database is attached electronically in Appendix VIII. Abbreviations used in the electronic database are listed below.

Classification – general alteration mineral groups (e.g., sericite, chlorite, carbonate)

Sample – Name of sample using drill hole name followed by meterage.

Hole_ID – Drill hole from which sample was taken.

Depth From – Start of sample interval from which sample was taken.

Depth To – End of sample interval from which sample was taken.

From_East – Easting of sample on local mine grid (using “Depth From”).

From_Nth – Northing of sample on local mine grid (using “Depth From”).

From_RL – Elevation of sample (using “Depth From”).

AMG East – Easting of sample on Australia Map Grid 66_zone 55.

AMG North – Northing of sample on Australia Map Grid 66_zone 55.

Instrument – Model of instrument used.

TSA_S Mineral1 – most dominant infrared-active mineral as recognised by the TSG software

TSA_S Weight1 – relative fraction of mineral1

TSA_S Mineral2 – second most dominant infrared-active mineral recognised by TSG

TSA_S Weight2 – relative fraction of mineral2

TSA_S Error – measure for each Mineral1 and Mineral2 match, which is termed the Standardised Residual Sum of Squares

w2200 – wavelength at minimum near 2200 nm

hqd2200 – depth of apparent feature at w2200

width2200 – width ot wav of the trough at minimum near 2200 nm

w2250 – wavelength at minimum near 2250 nm

hqd2250 – depth of apparent feature at w2250

w2350 – wavelength at minimum near 2250 nm

hqd2350 – depth of apparent feature at w2350

width2350 – wavelength at minimum near 2250 nm

hqd1900 – depth of apparent feature at w1900 (illite crystallinity feature)

Sericite Composition – the filtered/accepted values of w2200

Sericite Abundance – the filtered/accepted values of hqd2200

Chl Fe Comp – the filtered/accepted values of w2250

Chl Fe Abundance – the filtered/accepted values of hqd2250

Chl Mg Comp – the filtered/accepted values of w23250

Chl Mg Abundance – the filtered/accepted values of hqd2250